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**THE REPRESENTATION OF CONCEPTUAL AND
SYNTACTIC INFORMATION DURING SENTENCE
PRODUCTION**

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Ph.D

UNIVERSITY OF EDINBURGH

2008



Declaration

No portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

29th February, 2008

Mikihiro Tanaka

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Abstract

Current theories of language production assume that there are a number of independent stages which deal with the information involved: Conceptualization, Formulation and Articulation (Bock & Levelt, 1994, Levelt, 1989, Garrett, 1980). One aspect of formulation concerns the construction of syntactic structure. My main concern in this thesis is how we carry out syntactic processing in sentence production. In particular, the current study explores the representation and the mechanism underlying the production of syntactic structures and word order, and how these are affected by conceptual factors, focusing on animacy.

In this thesis, two different types of psycholinguistic experiments are presented. First of all, two recall experiments that investigated how non-linguistic factors such as animacy affect syntax in language production are discussed. In Experiment 1, Japanese speakers were more likely to recall Object-Subject-Verb (OSV) sentences as Subject-Object-Verb (SOV) sentences when this allowed an animate subject to appear first than when it allowed an inanimate subject to appear first; there was no such tendency for SOVs to be recalled as OSVs or for conjunct order to vary according to animacy. Experiment 2 showed that speakers again recalled OSVs as SOVs more often when this led to an animate-first sentence. However, they also displayed a tendency to recall sentences in the alternative voice (recalling actives as passives and vice versa) when this allowed the animate entity to appear as the subject. Such results provide evidence that animacy affects both grammatical function assignment and word order in Japanese sentence production.

Secondly, I report three syntactic priming experiments. Syntactic priming is the tendency for speakers to show a reliable increase in the use of particular syntactic structures after repeating or hearing those structures in an unrelated sentence (e.g., Bock 1986). Although in Experiment 3 and 4, Japanese speakers showed significant priming effects for word order and voice, there was no effect of conceptual priming: Participants were no more likely to assign an animate entity as the subject function or first position in the word order after hearing a sentence in which an animate entity appeared in the same position than after hearing a sentence in which it appeared in an alternate position (such as the object or in the second position). In addition, Experiment 5 confirmed that English speakers showed very similar results.

Taken together, these results suggest that grammatical functions and word order are determined during the same stage of processing, and that animacy exerts its effects on this single stage. The finding that priming occurs for choice of both word order and voice in Japanese is interpreted as being consistent with an extended model of production explained by the lexico-syntactic representation of the lemma stratum (Branigan et al., 2008; Pickering & Branigan, 1998). This suggests that the combinatorial nodes of the

lemma are linked to grammatical functions (voice) and constituent structure (word order).

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Chapter 1 Introduction

1.1. Introduction

Speaking requires many complicated processes. In order to speak, there are many stages to go through, such as finding the appropriate words, and computing the syntactic, morphological and phonological properties of these words. Research on language production is concerned with identifying how a speaker's thought is translated into a sentence which is syntactically and phonologically well-structured.

This requires us to take not only a single-language perspective, but also a cross-linguistic one. Let us consider a Japanese example. In Japanese, there are two different aspects that can be varied: word order (Subject-Object-Verb (SOV) or Object-Subject-Verb (OSV)) and voice (active or passive), and both of these can be varied simultaneously. Thus, when Japanese speakers want to describe a situation like '*Five people carrying the boat*', it is possible to describe this situation in four ways, SOV-active (*Five people carried the boat*), OSV-active (*The boat (Object), five people carried*), SOV-passive (*The boat was carried by the boat*), OSV-passive (*By five people (oblique-object), the boat was carried*). Although the four sentences may have slight pragmatic differences (e.g., OSV orders may focus more on the Object phrase, Yamashita, 2002), they basically do not show any denotational semantic differences. However, the speaker must choose one of them in order to communicate the message. How does he/she choose one sentence to describe the situation he/she wants to describe?

This issue is one of many underlying the question of how speakers produce sentences. The main issue of this thesis is the investigation of the processing mechanisms of language production. In particular, it will explore the detailed process of how conceptual information is transformed into grammatical

information in production. Throughout the thesis, I will examine the notion of ‘animacy’ and how it influences the syntactic mechanisms of language production, looking in particular at the choice of syntactic structure. I will examine its influence through experiments using two different experimental paradigms (sentence recall and picture description tasks).

In addition, it is important to examine production processes from a cross-linguistic perspective, in order to investigate whether it is possible to develop a universal model of language production. Thus in this thesis, although most experiments are concerned with Japanese, I will also include one experiment conducted in English so that it is possible to examine the cross-linguistic applicability of our models of language production, with particular reference to the production of different syntactic structures and word order.

1.2. Outline of thesis

The outline of the thesis is as follows. In Chapter 2, I overview the current models of language production (e.g., Bock & Levelt, 1994; Levelt, 1989; Levelt, Roelofs & Meyer, 1999). I particularly review how the model has been developed through empirical research, including speech error analysis, neurological research and experimental research, and I will discuss the details of grammatical encoding. This chapter also examines an alternative model of production, which in particular allows feedback from a lower level to a higher level. The last section of this chapter discusses the differences between psycholinguistic and computational models of language production.

In chapter 3, I examine how grammatical encoding is influenced by one conceptual feature, that of animacy. The notion of animacy is central to this thesis, and I will demonstrate how it has played an

important role in theoretical linguistic and psycholinguistic accounts of language. The thesis then reviews the empirical data from psycholinguistic experiments which have investigated the effect of animacy on sentence formulation in English and other languages (Greek, Spanish, German and Odawa) and discusses how these studies contribute to the controversy surrounding the effect of animacy on production. Then I will introduce two sentence recall experiments conducted in Japanese, which investigate the influence of animacy in Japanese sentence formulation. This chapter ends with a discussion of how the results of previous empirical studies and the current studies differ, and how such results could be interpreted under the current model of production.

Chapter 4 discusses the phenomena of ‘syntactic priming’. I will overview empirical findings from picture description tasks, and discuss how such studies are important in investigating the process of language production. In particular, this chapter focuses on one study by Bock, Loebell and Morey (1992) which investigated the animacy effect using a picture description task. I then introduce Experiments 3 and 4 (conducted in Japanese), which also used the picture description task, and see how the current studies differ from Bock et al. (1992). To investigate this issue more, Experiment 5 (which was conducted in English) is introduced in order to compare all the experimental results in Japanese and English.

Chapter 5 summarises the main findings of the thesis, concluding that I have explored new areas of language production research. It aims to examine how psycholinguistic experiments on animacy can help us to determine the structure of grammatical encoding. In addition, it notes that such studies show some interesting comparisons between English and Japanese, reinforcing the importance of a cross-linguistic perspective.

Chapter 2 Sentence production: literature review

2.0. Overview

In this chapter I will discuss how research on language production has developed, and will review the current theories of language production. This chapter is organized as follows: I will start off by reviewing the current models of language production in general. I will then examine how empirical studies such as speech error analysis, neurological research and experimental research have contributed to develop such models. The next section will focus on the details of grammatical encoding, how syntactic structure is constructed during sentence formulation. I will then discuss the information flow whether models of language production only allow a flow from a higher level to a lower level, or they allow feedback of information from a lower level to a higher level. The last section of this chapter will discuss two main views of syntactic formulation and word order construction, one based in psycholinguistics, and another based on computational models.

2.1. Theories of language production

The study of language production has developed in many different ways. Most early empirical studies of language production were based on the analysis of incomplete speech production: speech errors (Fromkin 1971, 1973; Garrett, 1975; Dell & Reich, 1981; Meringer & Meyer, 1978), hesitations (Butterworth, 1980; Goldman-Eisler, 1968; Beattie & Butterworth 1979), self-repairs (speakers correcting their own errors; Schegloff, Jefferson, & Sacks 1977), and other language pathology, such as anomia (Kay & Ellis, 1987). Some of the first models of speech production were developed on the basis of such studies.

In speech error analysis, researchers usually examine and analyse corpora of speech errors. However, there are several potential problems with speech error analysis. First of all, for instance, the error rate found by Garnham, Shillcock, Brown, Mill, and Cutler (1982) was only 1.5 sound errors and 2.5 word errors per 10000 words, suggesting that there are some errors which may be difficult to detect because they do not occur very frequently. In addition, there are some errors which may not be heard at all (Fromkin, 1971, Cutler, 1982, 1988). It can also be very difficult to classify speech errors into types (Cutler, 1988) since there are sometimes several types of errors mixed into one; for instance, the error in "*start the boat on the motor*" (intended: *start the motor on the boat*) could be due to a simple exchange of the words *boat* and *motor*, or a misassignment of two complete noun phrases, "*the boat*" and "*the motor*." (Bock, 1996).

Secondly, it is impossible for researchers to manipulate experimental conditions when using corpora of spontaneous speech. This is because corpus work limits us to using data which have already been produced, and does not allow us to explicitly manipulate the factors of interest. Moreover, it is possible that some of the incomplete speech in these corpora could be the result of abnormal behaviour rather than normal speech (Branigan, 1995).

Despite such potential problems, speech error analysis has certainly inspired many researchers' work. In order to overcome the difficulties posed by analysis of spontaneous speech errors, recent research on language production has focused on experimental studies (e.g., Bock 1987b; Levelt 1989; Bock & Levelt, 1994). Experimental studies allow for a more direct manipulation of factors of interest. Tasks such as syntactic priming (e.g., Bock, 1986a; Bock & Loebell 1990), priming-picture description, where subjects who first produced a prime sentence with a given structure were asked to describe a picture of a conceptually unrelated event. (e.g., Bock 1986a; Igoa 1991; Bock, Loebell & Morey, 1992), and

picture/film description, where participants were asked to describe what is happening in the picture/film, (e.g., Harris, 1978; MacWhinney & Bates 1978; Bates & Devescovi, 1989) involve people freely describing whatever comes into their mind, whereas production tasks like sentence recall (e.g., Bock & Irwin, 1980; Bock & Warren, 1985; McDonald, Bock & Kelly, 1993) are more restrictive.

Other models have been proposed from a more computational point of view (Kempen & Hoenkamp, 1987; de Smedt & Kempen, 1987, 1991). Although such models are computationally implemented, it is important to note that these computational models still aim to be psycholinguistically plausible. This means that these models take into account all sorts of psychological data on how speakers produce natural language utterances.

Although the details of each model are slightly different, there is reasonable agreement on the basic architecture of the language production system. Based on the analysis of Garrett (1980, 1982, 1988), followed by Levelt (1989), Bock and Levelt (1994) and Levelt, Roelofs, and Meyer, (1999), current models of language production distinguish between three different levels of processing – *Conceptualization*, *Formulation* and *Articulation*. Formulation is furthermore divided into two different processing levels, one is *grammatical encoding*, whereby the syntactic information of appropriate lexical elements is retrieved and used to generate syntactic structure, another is *(morpho)phonological encoding*, whereby the morphophonological contents are generated. The basic model of production is shown in Figure 1.

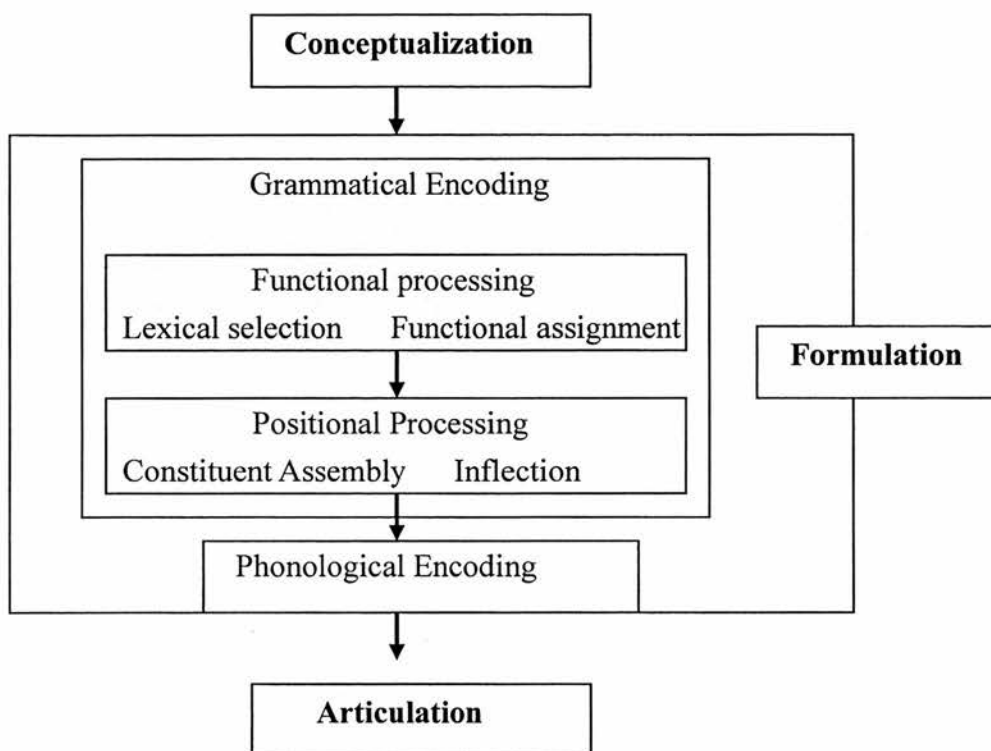


Figure 1. The architecture of the language production system, taken from Bock and Levelt (1994), Garrett (1980), Levelt (1989) and Levelt et al. (1999)

As an outline, at the level of conceptualization, it is generally accepted that speakers begin by deciding to express a meaning at the stage of message generation, and then they try to map this pre-linguistic message onto the appropriate lexical concepts and their associated lemmas - the syntactic component of lexical entries (Levelt, 1989; Levelt et al., 1999; Kempen & Huijbers, 1983). Syntactic structure is then generated from the syntactic information contained within the lemmas (Kempen & Hoenkamp, 1987). This linguistic information is finally converted into phonological items.

Most models of production agree that each level of processing works independently, so that the necessary information has to be dealt with at each stage. Thus, for instance, the grammatical encoding information should be dealt with at its own level, and this level will not take into account other data such

as conceptual or phonological information.

More importantly, I also assume that language production is incremental (Kempen & Hoenkamp, 1987; Levelt, 1989; Bock & Levelt, 1994; Levelt et al., 1999). It is likely that the production system is designed in a way that allows it to be quick and fluent; otherwise our conversation would consist of silences and pauses. In this sense, it is assumed that as soon as a piece of information is available, the processor will allow this information to pass down to the next level. Thus many researchers suggest that the production system is highly incremental, so that processors do not need to wait until the next information is available before the current information is processed. Instead, processing goes on to the next stage as long as the minimal amount of information is formulated. I will take this view in this thesis.

2.1.1. Stages of language production

In this section, I will discuss how each stage in language production works. By looking at an actual sentence and at examples of speech errors, I will be able to examine what would actually happen in each stage of language production. In this section, I will use the example sentence '*Five people carried the boat*', and I will look in most detail at the levels that are concerned with syntactic processing.

First of all, at the level of *Conceptualization*, I assume that there is an intention of communication by the speaker. For example, a speaker sees a picture of 'Five people carrying the boat' and wants to tell a listener about this event. One way of expressing the content of this picture to the listener is to produce a verbal description, such as '*Five people carried the boat*'.

Thus, since I assume that a speaker has an intention to speak, then, in the next step the speaker will

engage in deciding how to communicate the intended message. In order to achieve this goal the speaker has to decide upon a *speech act*. In our example, the message will be translated into a declarative sentence. But it has to be decided if the message should be delivered as a declarative, interrogative, imperative or other type of sentence. In addition to this, the intended message will be affected by many different factors: e.g., the place where the conversation takes place, the speaker's role in the conversation and the previous messages (what has been previously said by other speakers) during the conversation. Taking account of all these factors is called *macroplanning* (Levelt, 1989).

Secondly, the speaker has to consider what sort of information should be expressed; e.g., what is the discourse topic, how should the entities be referred to (focused), or how should new information be included. Then the speaker should consider the informational perspectives they will take (e.g., the speaker's point of view, or the listener's) and any language-specific requirements. Such activities are called *microplanning* (Levelt, 1989).

The output of the message level is a pre-verbal message which will be passed into the next level, that of *Formulation*. Formulation is further divided into two different processes, one of which is *Grammatical encoding*. The precise nature of grammatical encoding is controversial, but most researchers agree that there is a split between *functional processing* and *positional processing*. In most current models of language production (e.g. Bock & Levelt., 1994; Levelt et al., 1999), these are assumed to take place consecutively: functional processing first, then positional processing. According to Levelt (1989), the processing of conceptualization is thought to be incremental. Thus, it is not necessary for a speaker to complete all macroplanning before microplanning can start. One can begin giving a route direction without having planned all its details.

Following Bock and Levelt (1994), during functional processing, in order to convey the message that was created in the message generation, the lexical concepts and lemmas (the grammatical contents of a lexical entry) of these messages have to be identified. Levelt et al., (1999) assume that a lexical entry is an item in the mental lexicon, which consists of a lemma, its lexical concepts and its morphemes with their segmental and prosodic properties. The lexical concepts are concepts corresponding to a lexical label, and a lemma contains an abstract representation which specifies syntactic information (e.g., grammatical gender or class). However, it does not include information about word-form properties. The process of retrieving lexical concepts and lemmas is called **lexical selection**. For example, in order to produce the message '*Five people carried the boat*', the speaker has to retrieve the lexical entries for two nouns (*five people, boat*), and a verb (*carry*) to express the event. The existence of such processing is reflected in **semantic substitution** errors, where the speaker makes an error in lexical selection. For instance, the speaker might intend to say '*Five people carried the boat*' but instead say '*Five people carried the car*'. These substitutions tend to involve words which contain some of the same semantic features as the intended word (Hotopf, 1980), and they also tend to occur between words of the same grammatical category, e.g., noun to noun, verb to verb. A corpus study of errors by Stemberger (1985) suggests that 99.7% of lexical substitutions occur with words of the same grammatical category. .

Another step of functional processing is called **function assignment**. This process deals with the assignment of grammatical functions (e.g., determining the subject, object etc). Thus when processing a sentence such as '*Five people carried the boat*', *five people* should be treated as a subject-nominative function, *boat* as an object-accusative function, and *carry* as the transitive main verb. These types of substitution error can be called **Exchange errors**, and they occur when two functions are linked to the wrong words. For example, when two nouns (*five people, boat*) are linked to subject and object functions, there is a possibility that speakers will link the wrong function to the wrong noun to produce an error like

'*The boat carried five people*', instead of '*Five people carried the boat*'. That these are not simple exchanges is demonstrated by a present-tense example: '*Five people carry the boat*' would be produced as '*The boat carries five people*'. The correct verb agreement here provides evidence that the processor has wrongly identified what the subject is.

The next stage is called **positional processing** (or the positional level). Although some grammatical aspects of an utterance are constructed during functional processing, the order of each phrase is not determined at that stage. The unordered sequence then has to be assigned a linear order during positional processing. However, it is important to note that, although the models of language production proposed by Garrett (1975, 1980) and recent studies (Bock & Levelt, 1994; Levelt et al., 1999) predict the existence of a positional level, there are some important differences between these models in terms of what information will be processed during the positional level. In Garrett's model, the positional level is thought to specify lexical or morphological content, whereas in recent models the positional level is assumed to be generated before word-forms or morphological markings have been retrieved. However, the evidence of positional processing discussed below is mostly based on Garrett's model of language production.

Evidence for positional processing comes from various studies. Exchanging whole words within the same phrase only happens 19% of the time in Garrett's corpus (1980), thus adjacency is not a strong factor to cause such exchanging words. However, Garrett also found that 87% of exchange sound errors happen within the same phrase (e.g., *sot holdering iron*) and these exchanges do not involve more than two or three words. Therefore, Garrett suggests that sound exchanges are evidence of a positional level. In fact, studies about language performance such as those on normal prosodic patterns (Cooper, Paccia & Lapointe, 1978; Grosjean, Grosjean & Lane, 1979) and hesitations (Boomer, 1965; Butterworth, 1980;

Butterworth & Beattie, 1978; Maclay & Osgood, 1959; see Garrett, 1982 for review) also show the existence of positional processing. For instance, Cooper et al. (1978) showed that their participants produced longer pauses and took more time to read the word *naturally* within 'My Uncle Abraham presented his talk *naturally*.' (Intended meaning is 'Of course Abraham presented his talk') than after the word *naturally* within 'My Uncle Abraham presented his talk *naturally*.' (Intended meaning is 'Abraham presented his talk in a natural way'). They concluded that longer pauses occurred when the word was within a different constituent than within the same constituent. In addition, sentence recall tasks conducted by Johnson (Johnson, 1965; 1966a, b) found that participants tended to recall words better within the same phrase than when they formed parts of a different phrase.

More convincing data for the existence of a positional level comes from experimental works by Bock and her colleagues (Bock, 1986a; Bock & Loebell 1990; Bock, Loebell & Morey, 1992). Bock (1986a) showed that her participants produced more Prepositional object (PO) target descriptions (e.g., 'The doctor gave the injection to the patient') after PO prime sentences (e.g., 'A rock star sold some cocaine to an undercover agent') than after Double object (DO) prime sentences (e.g., 'A rock star sold an undercover agent some cocaine'). They also produced more active target descriptions (e.g., 'Lightning is striking the church') after active prime sentences (e.g., 'One of the fans punched the referee') than after passive prime sentences (e.g., 'The referee was punched by one of the fans'), or more passive descriptions after passive prime sentences than active prime sentences. Bock argued that this was caused by priming of the processes responsible for creating syntactic structures in sentence formulation. Bock and Loebell (1990) furthermore showed that other similarities between the sentences were not responsible for the priming effect. For instance, locative sentences (e.g., 'The 747 was landing by the control tower') still primed passive sentences even if the type of event was different. Neither were prosodic structures the cause of the priming effect. For instance, *Susan brought a book to Stella* vs. *Susan brought a book to*

study are similar in terms of the subject noun phrase, metrical structure and position of closed-class words, the constituent structure of both examples are different. Bock and Loebell found importantly that the former example primed another PO sentence, the latter did not. This suggests that the processes responsible for the output are purely syntactic. I will discuss this issue in section 2.3.2.4.

There are two different aspects to positional processing. The first is called **constituent assembly**. This manages the order of word production and also specifies dependencies between syntactic functions. In English, word order is relatively restricted, in that the Object NP should follow the verb. However, in Japanese, the Object NP can either precede the verb (1-a) or follow the verb (1-b), allowing a choice between Subject-Object-Verb (SOV) and Object-Subject-Verb (OSV) order. The choice of which word order to produce would be determined at this point.

(1)

a. SOV in Japanese

5 人の人がボートを運んだ。

Gonin no hito ga booto o hakon-da.

Five people NOM boat ACC carry-PAST

'Five people carried the boat.'

b. OSV in Japanese

ボートを 5 人の人が運んだ。

Booto o Gonin no hito ga hakon-da.

Boat ACC Five people NOM carry-PAST

'Five people carried the boat.'

The second aspect is inflection. In English, elements such as number, tense (present, past etc) and aspect will be dealt with here. Thus, for example, the past tense form 'carried', in the sentence '*Five people carried the boat*' is determined here. As in constituent assembly, there are two types of speech errors that demonstrate the process of inflection. **Stranding** occurs when inflections are placed in the appropriate locations, but affixed to the wrong phrases, as shown in (2) and (3) (after phrases have undergone an exchange error).

(2) It just *sounded to start* (intended: *started to sound*; taken from Garrett 1975:150).

(3) You *ordered up ending some fish dish* (intended: *You ended up ordering some fish dish* (Garrett, 1993).

The elements that are exchanged are nearly always free forms, but the elements that are left behind are bound morphemes which are left in the original position. In Garrett's example, the suffixes *-ed* and *-ing* appear to be attached to the wrong phrases, but in the right order. This suggests that inflections and word stems are not always combined together, but are separately positioned.

In another type of error, called a **Shift**, the appropriate inflections are placed in the wrong locations (Garrett, 1975). For instance,

(4) She was *hand himming some broccoli* (intended; *She was handing him some broccoli*).

(5) He *get its done* (intended; *gets it done*. (taken from Garrett, 1975))

Such errors are not due to simple shifts of a final sound (*-er* of listener), but rather the misplacement of morphemes (*-ing* and *-s*), with progressive verb form inflections being attached to the pronoun rather than the verb. Thus such observations lead us to conclude that inflections are independently processed

during the positional level.

Another level of formulation is called *Phonological encoding*. According to Levelt (1989), at this stage, the phonological encoder retrieves the abstract representations of words from the lexicon, and they are mapped onto sounds that must be produced in the correct sequence. Apart from that, an item in the lexicon also contains information such as its morphology and its phonology, and it must be produced correctly. For instance, the word '*dangerous*' consists of a root (*danger*) and a suffix (*ous*). Additionally the word contains three syllables, the first syllable has the accent, and its first segment is /d/. Several phonological procedures will also modify, such as the sentence '*John gave Mary the book*' will need additional stress at the syllable /buk/ (*book*). The output of this stage is *Articulation*, in other words, a 'gestural score' (Levelt et al., 1999) that specifies how the muscles of the articulatory system should be moved.

In sum, this section has reviewed the basic models of language production. In the following section, I will examine in more detail theories of lexical access in language production.

2.2. LEXICAL ACCESS

In the previous section the three different stages of language production system, conceptualization, formulation and articulation, were reviewed. In this section I will review lexical access, in other words, how entities stored in the mental lexicon are accessed. I will discuss a two-stage model of lexical access, and the evidence for this, by looking at speech errors and experimental studies.

2.2.1. Lexical access

Empirical research assumes that lexical access includes two stages, Lemmas and Word-forms. Both are parts of a lexical entry, but Lemmas contain semantic and syntactic information, whereas Word-forms contain phonological/morphological information. Empirical research suggests that lemmas are retrieved at the functional level, and word-forms at the phonological level (Levelt & Maassen, 1981; Kempen & Huijbers, 1983; Levelt, 1989; Levelt et al., 1999). The details of the conceptual level, lemma level and word-form level are given in Figure 2.

The evidence for two-stage lexical access (Lemmas and Word-forms) comes from many different types of study, such as those looking at the tip-of-the-tongue phenomenon (Brown & McNeill, 1966; Jones & Langford, 1987; Meyer & Bock 1992; Vigliocco, Antonini & Garrett, 1997; Vigliocco, Vinson, Martin & Garrett, 1999), neuropsychological studies (Buckingham, 1979; Badecker, Miozzo & Zanuttini, 1995; Henaff Gonon, Brucket & Michel, 1989; Garrett 1984; Vigliocco, Garrett, & Martin, 1996), speech errors (Fromkin 1971; Garrett 1975, 1988), and experimental studies (Levelt et al., 1991). In contrast, there are some models which do not involve the lemma level, proposed by Caramazza and his colleagues (e.g., Caramazza & Miozzo, 1997; Miozzo & Caramazza, 1997). I will review these studies below.

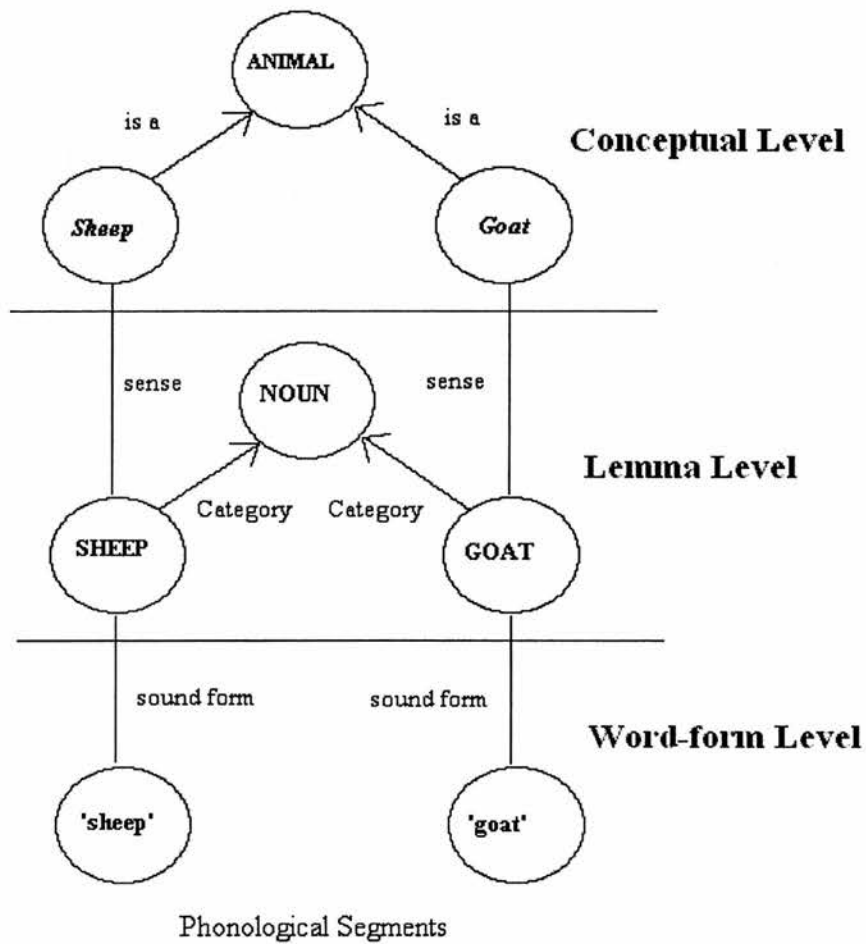


Figure 2: The model of lexical access (adopted from Levelt et al., 1999)

2.2.2. The tip of the tongue phenomenon

Tip-of-the-tongue (TOT) states are important evidence that there is a stage of processing where speakers can access conceptual and syntactic information without also accessing phonological information. TOT is the phenomenon when a speaker knows a word he/she wants to say but cannot recall it. TOT states were originally described by William James (1890/1950), and discussed later by Woodworth (1938). Then Brown and McNeill (1966) systematically studied TOT states in experimentally

for the first time. In their experiment, participants read definitions of uncommon words and then had to recall the word. Brown and McNeill's results suggested that in many cases participants knew the initial consonant or vowel, or syllables and stress pattern, but not the overall pronunciation.

Another experimental study by Jones and Langford (1987) showed more evidence of TOT states. In their experiment, some definitions of particular nouns were presented by the experimenter, and participants were shown 'blockers' which included high frequency or low frequency words, and which in many cases were phonologically or semantically related to the target. After the presentation of these blockers, participants were asked to write down the target word. Participants were asked to fill in the remaining column if they were in a TOT state – '*Present?*' was marked if participants think they know the word and thought they could produce it if they had a little more time. '*first or last letter?*' '*Number of syllables?*' and '*anything else?*' were marked if they had this knowledge of the sought-after target word. Jones and Langford found that their participants tended to have more TOT states when the blocking words were phonologically related to the targets than when they were phonologically unrelated. On the other hand, the TOT state was not affected by the blocker's frequency.

However, since Jones and Langford (1987) focused on the effect of interlopers on the TOT states but not on the incidence of successful target retrieval, and indeed correct retrievals of the target description were not reported, Meyer and Bock (1992) suggested that it may not be plausible that Jones and Langford's data could be used to investigate the broader issue of the nature of the selection mechanism. Thus, Meyer and Bock suggested that '*...the findings do not reveal whether the TOT states were positively or negatively correlated with the accessibility of the targets.*' (Meyer & Bock, 1992: p716)

A further aspect of Jones and Langford' (1987) problem (also Jones, 1989) is their methodological

and experimental design. Although Jones and Langford found that the phonologically related target words were associated with significantly more TOT states, the paradigm and the experimental design may be problematic. For instance, Perfect and Hanley (1992) pointed out that the target words and definitions used in phonological interloper conditions were never paired with phonologically unrelated interlopers or with no interlopers at all. Thus, Perfect and Hanley claimed that the target words would still be associated with a relatively high number of TOT states even if phonologically related interlopers were not presented.

Therefore, Meyer and Bock (1992) showed evidence against the finding by Jones and Langford. In Meyer and Bock's experiment, participants were asked to produce responses to definitions such as the target *sextant* as '*an instrument used for measuring angular distances, used especially in navigation to observe the altitude of celestial bodies*'. Definitions were accompanied by three different cues: phonological cue (related in sound to the target), semantic cue (related in meaning to the target) and unrelated cue (unrelated to the target). Meyer and Bock found that participants produced more correct responses following phonological cues than unrelated one. This shows that phonological information provides activation in lexical selection, and thus Meyer and Bock concluded that the TOT state is due to partial activation of the target word rather than blocking the target word.

Vigliocco et al. (1997) furthermore investigated if speakers had access to syntactic information while they were in TOT states. They presented definitions of Italian words and asked participants to provide the word that matched the definition. If they felt they knew the word but could not recall it immediately, participants had to answer several questions regarding the word; e.g., how well they felt they knew the word, what gender the word had, how many syllables the word had, what letters it had or any related words that came to their mind. Vigliocco et al., found that their participants had access to some of the information about the word; for instance, over 80% of participants recalled the grammatical gender of the

word correctly. They suggested that such a result was evidence of two separate stages of lexical access, where syntax is represented independently from word-form. Thus they concluded that speakers in a TOT state had access to a word's lemma but not its word-form.

Vigliocco et al. (1999) investigated if speakers in a TOT state can access count and mass information. In English it is possible to make the distinction between 'count' nouns (e.g. mushroom) and 'mass' nouns (e.g. broccoli). As in Vigliocco et al.'s (1997) experiment, Vigliocco et al. (1999) presented definitions or pictures of words to the English speakers and if they could not recall the word, participants were asked about what features of the word they had access to. As in the case of grammatical gender in Italian, Vigliocco et al., found that their participants could guess if the word was a count or mass noun. Vigliocco et al. (1999) also tested an anomic speaker who experienced word retrieval difficulties if the anomic speaker could get the information about definitions and pictures which he could not provide the word for although he felt he knew it. Like normal speakers, he showed an ability to accurately guess whether the word he was trying to produce was a mass or count noun. These findings were important as, unlike grammatical gender in Italian, there was no phonological correlation with whether a noun was count or mass. In short, the finding that count and mass information was available without the word's phonological form was once more evidence of a two-stage model of lexical access, where the selection of an abstract representation specified for meaning and syntax (i.e. lemma) precedes the retrieval of the word's phonological properties.

Most of the evidence about TOT states comes from studies of normal speech. However, research on anomic aphasic patients has revealed that these patients experience TOT states too. Anomic aphasic patients have some deficits in their speech production, for instance accessing their word production. However these patients can describe or produce some gestures relating to the target word. Buckingham

(1979) reported that patients may describe pen as '*It's for writing*', or show a writing gesture, but they cannot express it with the appropriate word. Vigliocco et al. (1999) also ran an experiment where an anomic speaker was asked for information about definitions and pictures. Their patient showed an ability to guess whether the words that they were trying to produce were mass or count nouns. There are also several other studies who found similar effects. Badecker et al. (1995) reported that, while an Italian anomic patient was able to identify the grammatical gender of words, he was unable to produce the correct word-form. In addition, Henaff Gonon et al. (1989) reported similar results from a French-speaking aphasic patient. Thus, the fact that anomic patients could retrieve syntactic information in the face of severe difficulties retrieving word forms provides evidence of two stages of lexical access, syntactic and phonological information.

In sum, such evidence of the TOT state from normal speakers and anomic patients supports the idea that they can report a good deal of syntactic information about the target even though they can retrieve little or no phonological information, so lemma and word-form retrieval take place separately.

It is worth noting that some researchers do not agree with the conclusion that the TOT data is supportive of the lemma model. For instance, Caramazza and colleagues (e.g., Caramazza & Miozzo, 1997; Miozzo & Caramazza, 1997) have questioned the lemma model of lexical access. Instead, they have proposed a model of language production called the Independent Network model of lexical access (IN model). Compared to the lemma model, the crucial difference in the IN model is that there is a direct link between semantic and word-form levels and this word-form level includes lemma information and corresponds to lemmas in the lemma model in that they are linked to syntactic and word-form information. Thus, word-forms and syntactic nodes in the IN model are represented at the same level. In the IN model, there is no lexical level where semantic and syntactic information are represented independently from

word-form information.

Much evidence for this model comes from Italian patient data by Caramazza and Miozzo (1997). They examined the correlation of TOT data between the correct retrieval of gender and the correct retrieval of an initial phoneme in Italian speakers in an induced TOT state. In Caramazza and Miozzo's experiment, their participants were given definitions and asked to words to match the definition. If they felt they knew the word, they were asked to recall any gender or phonological information. Caramazza and Miozzo found that participants could correctly produce partial information about the noun but there was no correlation between the correct retrieval of grammatical gender and initial phoneme. In addition to this, they also found that successful retrieval of grammatical gender was no more common than successful retrieval of partial phonological information. This is not consistent with a lemma model because the lemma model would predict that the lemma level intervenes between semantic and word-form information, thus the correct retrieval of partial phonological information would imply that grammatical gender should be successfully retrieved.

Caramazza and Miozzo (1997) also found evidence that successful retrieval of partial phonological information was not dependent on successful retrieval of syntactic features. They argued that a lemma model would predict that correct retrieval of grammatical gender should be more frequent than correct retrieval of phonological information, as grammatical information precedes word-form information. However they found that this was not the case. Therefore, Caramazza and Miozzo claim that their data is not compatible with a lemma model of word production. Instead, Caramazza and Miozzo claimed that since syntactic information and phonological information are represented at the same level in the IN model, and that their result is consistent with the IN model that speakers have access to phonological information without access to syntactic information.

Roelofs, Meyer and Levelt (1998) replied to Caramazza and Miozzo (1997) by arguing that there is a distinction between activation and selection; activated information is only selected when it is needed. Thus a speaker could have selected the lemma of a word without selecting the grammatical information associated with it. Roelofs et al. (1998) cited some picture-word interference experiments to support their hypothesis. Schriefers (1993) showed that when speakers were asked to produce a noun phrase and a determiner shares the same grammatical gender as a distractor, latencies were shorter than when the noun and distractor did not share the same gender. Jescheniak and Levelt (1994) found that when speakers were asked to produce bare nouns, the grammatical gender of the distractor did not influence latencies. Roelofs et al. (1998) claimed that the grammatical gender of a word is not necessarily accessed when it is not needed, otherwise latency effect would occur regardless of whether a determiner was produced. Hence, Roelofs et al. (1998) concluded that a speaker can access a lemma without accessing its grammatical gender. Further discussion of this issue is beyond the scope of this thesis. Thus in this thesis, we assume the Levelt et al.'s (1999) two-stage process in lexical access, lemma and word-form.

In sum, while several researchers claim a two-stage lexical access (Lemmas and Word-forms) in word production, Caramazza and his colleagues (e.g., Caramazza & Miozzo, 1997; Miozzo & Caramazza, 1997) suggest an alternative model of lexical access which does not involve the lemma access.

2.2.3. Speech errors

Evidence of a two-stage process in lexical access also comes from empirical research on speech errors. Although there are several types of errors that speakers can produce, some errors seem to show evidence of a distinction between grammatical and phonological encoding. These errors are semantic substitutions (producing the wrong word in place of another), blends (producing a blend of two words), and exchanges

(where elements in a sentence are produced in the wrong positions). Although much of this evidence is semantic but not grammatical, some errors may contain both semantic and grammatical aspects.

Semantic substitution means that the speaker uses a wrong word instead of using the intended one (in the example below, the alternative word is *written*, and intended one is *read*).

(6) *I would like to see it now that I've written the book, uh, read the book.*

This type of error represents the use of a word other than the one intended. Generally, the elements involved in semantic substitution errors belong to the same form class (e.g., noun, verb, adjective, adverb, or preposition), and they are antonyms or pragmatic opposites. Such an error provides evidence for lemma retrieval as an independent stage.

Most *Blends*, like those in (7), involve two words that are nearly synonymous, and that belong to the same form class (e.g., verb-verb, noun-noun). However, compared with substitution errors, blends errors are more complicated, since this type of error exhibits both a semantic and a phonological relationship. As in (8), though it is an example of sentence blends, their antecedent (*Sky*) is early, but the error of phonological merging (*shining*) is late. The merging is phonologically systematic, respecting the syllable constituency of both components (MacKay, 1972; Wells, 1951). It is suggested that this late merging is the result of two different encodings occurring in parallel (Butterworth, 1982; Garrett, 1980; Harley, 1984), which suggests a two-stage process between grammatical and phonological encoding.

(7) *The competition is a little stougher (Stiffer/tougher)* (Fromkin, 1973)

(8) *The sky is shining (The sky is blue/The sun is shining)* (Harley, 1984)

The third type of speech error is called *Exchanges* (word or sound exchange). Exchanges include two types, word and sound exchanges, and such a distinction is evidence of a two-stage process between grammatical and phonological encoding (Garrett, 1975; Bock & Levelt, 1994).

Word exchanges usually only occur when both words' syntactic categories are the same (e.g., the same form class). Garrett (1980) reported that this is the case in more than 80% of word exchanges.

(9) *Seymour sliced the knife with a salami* (Fromkin, 1973)

In example (9), the noun '*knife*' was exchanged with another noun, '*salami*'. In addition, word exchanges can involve phrases, and syntactic features do not tend to exchange with the main word stems. In example (10), the intended message was *a floor full of holes*, and when the nouns *floor* and *hole* exchanged, the error utterance remains syntactically correct, but the word *hole* left its inflectional marking 's' behind.

(10) *a hole full of floors* (intended message was '*a floor full of holes*', Fromkin, 1973)

In contrast, sound exchanges do not seem to involve the grammatical class of the words, but these happen when the phonological categories of two words are similar (as in example (11)).

(11) *Blate fruid* (*brake fluid* was intended, Fromkin, 1973)

Such exchange errors indicate that there is a dissociation of processing between grammatical encoding and phonological encoding.

Malapropisms are errors which provide evidence for a stage of processing that is concerned with phonology. These errors have similarities to semantic substitutions and blends, but occur when two words share some phonological properties and they tend to be adjacent (adjacent words are rarely the same form-class), but do not share semantic properties (Fay & Cutler 1977).

(12) *If these two vectors are equivocal, then ... (intended: equivalent)*

Thus, while speech errors such as semantic substitutions, blends and exchanges seem to reflect a level of processing that is concerned with semantic content, malapropisms seem to be related to phonological features. These differences indicate that there are two different stages in lexical access, semantic/syntactic and phonological processes.

2.2.4. Experimental studies

Experimental studies also suggest that there is a split between lemma selection and phonological encoding (e.g., Levelt, Schriefers, Vorberg, Meyer, Pechmann & Havinga, 1991a; Schriefers, Meyer & Levelt, 1990; Schriefers, 1990).

Levelt et al. (1991a) conducted picture-word interference experiments to investigate whether there is a dissociation between semantic and phonological activation. In Levelt et al.'s experiments, the participants' task was picture naming (primary task) and a decision of whether a presented test probe was an existing word or non-word (secondary task). In this secondary task, an acoustic test probe was occasionally presented immediately a picture was presented. Participants had to make a lexical decision to whether the probe was a word or not, and then name the picture presented.

Levelt et al. (1991a) measured the effect of Stimulus onset asynchrony (SOA) to see if such a decision time will be influenced by the probe. The test probe in the actual experiment was either semantically or phonologically related to the target picture. For instance, before a target picture such as *sheep* was presented, participants heard the semantically related word *goat* or phonologically related word *sheet*. If lexical selection was affected by semantically related words and phonological encoding (word-form) was influenced by phonologically similar words, these results would agree with a two-way process in lexical access, rather than a feed-forward model (from the word-form to the lemma level) by connectionists (e.g., Dell, 1986; MacKay, 1987; Stemberger, 1985). Levelt et al. (1991a) found that although lexical decision times for semantically related words were affected at early SOAs only, such decisions for phonologically related words were affected at all SOAs. Thus these results suggest that semantic processing precedes phonological processing. Furthermore, there was no reliable effect of the mediated prime words—lexical decisions to the probe word *goal* presented with a picture of a ‘sheep’ were no different from those for an unrelated word paired with the picture. These results suggest that partially activated lemmas do not pass on activation to a set of word forms that are phonologically similar to one another, supporting a discrete model of lexical access.

Schriefers et al. (1990) also ran the picture-word interference paradigm. In their task, they presented distractors auditorily to measure SOA, and such distractors included unrelated words, phonologically related words, and semantically related words. They found that there was an early effect of semantic interference on picture naming when semantically related words were presented early (-150ms SOA), that is, 150ms before pictures were presented. In contrast, there was a later facilitation effect of phonological distractors at 0ms (there was 0ms between the presentation of the picture and the presentation of the auditory distractor) and +150ms (150ms after picture onset). The crucial finding was that there was no overlap between the semantic inhibition effect and the phonological facilitation effect. Schriefers et al.

(1990) concluded that there was a stage of lexical access at which only the meaning of a word was activated, followed by a stage where only its word-form was activated. This fits the assumption that semantic processing precedes phonological processing and is also consistent with a feedforward model of lexical access (e.g., Levelt, 1989; Levelt et al., 1999). However, this result should be interpreted cautiously since Starrevelt and La Heji (1996) (also Starrevelt & La Heji, 1995) found that the results depend on whether distractors were presented visually or auditorily. When Starrevelt and La Heji presented distractors visually in their experiment, they found the early phonological effects and late semantic effects. Such a finding stands in contrast to the results of Schriefers et al. (1990).

More recent picture-word interference studies appear to support the interaction models under some circumstances (or at least cascading models) (e.g., Peterson & Savoy, 1998; Cutting & Ferreira, 1999; Griffin & Bock, 1998; Damian & Martin, 1999). Peterson and Savoy (1998) presented participants with pictures to name. In their experiment, a visual target word was occasionally presented following the picture, and their participants were asked to name the word. The names of the critical pictures were near synonym, such as *sofa* and *couch*. They are nearly interchangeable, therefore Peterson and Savoy claimed that the lemmas of the two words are likely to have some overlapping semantic preconditions. Thus, both lemmas should be highly activated and phonological word forms that are phonologically similar to the two alternative words (e.g., *count* and *soda*) should receive detectable partial information. In fact, their speakers showed at early SOAs, semantically mediated phonological primes (*soda* for naming a picture of *couch*) were named more quickly than unrelated words. Peterson and Savoy argued that this finding was in contrast to Levelt et al.'s (1999) claim that only one lemma can activate a phonological form, but instead it was consistent with a cascaded account of lexical access, where multiple lexical items could receive phonological activation during production.

Damian and Martin (1999) ran the similar picture-word interference tasks by Schriefers et al. (1990). The main difference from Schriefers et al. (1990) was that Damian and Martin added one condition called 'semantic and phonological condition', the distractor (such as 'apple') was phonologically related as well as semantically related to the target word 'apricot'. They found the early semantic inhibition (-150ms and 0ms SOAs) and late phonological facilitation (0 ms and +150 ms SOAs). Compared to Schriefers et al. (1990), Damian and Martin's (1999) results showed an overlap effect between semantic inhibition and phonological facilitation. However, they did not find any early semantic inhibition in the semantic and phonological condition. This demonstrates that semantic interference is reduced in the simultaneous presence of a phonological relationship. Thus, Damian and Martin's finding appears to contradict the 'discrete two-step' account by Levelt et al. (1999)¹.

Further discussion of these two models would be beyond the scope of this thesis. To summarize, experimental studies using the picture-word interference task have proved to be informative about the time-course of language processing. While Schriefers et al. (1990) and Levelt et al. (1999) claim the discrete two-step account of lexical access, other studies (e.g., Peterson & Savoy, 1998; Damian & Martin, 1999) have shown evidence of interactive model of lexical access.

2.2.5. Summary

In sum, I have reviewed the evidence that lexical access involves a two-stage process. Lemmas are retrieved at functional processing, and word-forms are retrieved in a subsequent stage. Several studies including studies of the tip-of-the-tongue state, neuropsychological research, speech errors and other

¹ Levelt (1999) responded to this claim that interactiveness between a lemma node and a word-form node could be '...merely a property of the error mechanism: an error might occur precisely then when undue interactivity arises in an otherwise discrete system' (Levelt, 1999, p225).

experimental methods show evidence of a two-stage process in lexical access.

2.3. Details of grammatical encoding

Now I have studied the details of lexical access, I will examine grammatical encoding. As discussed in the previous section 2.1, grammatical encoding has two different processes, functional and positional processing. In this section, I will review the evidence for each level of processing and how they work individually.

2.3.1. Functional assignment

As briefly discussed previously, there are two different stages to functional processing. The first is lexical selection. This stage involves lemma selection from the mental lexicon, and at this point all the nodes which share similar semantic features are activated. For instance, when a word *CAT* is processed, all other nodes under the category of *ANIMAL* (e.g., *DOG*, *HORSE*) would be activated.

According to Levelt et al. (1999) (also Roelofs, 1992, 1993), activation starts at the conceptual level, then spreads some of its activation to its lemma node. How a lemma is retrieved is a result of 'a statistical mechanism' (Levelt et al., 1999): the highest activated lemma is retrieved. As a result, only the retrieved lemma activates a word form but less activated ones do not activate word forms. For instance, when a concept of a *CAT* is activated, the lemma *cat* will be activated. This also causes the activation of attributes relating to that lemma, such as noun and feminine. This furthermore activates other lemmas, such as *DOG*. When a speaker makes the correct lexical selection, then the lemma *CAT* will be retrieved. When a speaker makes the wrong lexical selection, the wrong lemma *DOG* is retrieved instead of *CAT*. Hence,

Levelt et al. (1999) claim that their model does not allow 'cascading' activation, which means the information flow of activation cannot take place to a later level before a decision has been reached at the earlier level.

Function assignment is the second stage of functional processing. This involves the assignment of grammatical functions (e.g., subject, direct object) to the retrieved lemmas. It also involves the retrieval of noun and verb lemmas. It is assumed that verb lemmas specify grammatical functions; e.g., if the verb lemma is transitive, in the case of English, the verb will be associated with two sets of grammatical functions: the subject and the direct object in an active sentence (e.g. *Five people carried the boat*), or the subject and oblique object in a passive sentence (e.g., *The boat was chased by five people*). Each noun lemma is tagged for one of the grammatical functions (such as subject, object or oblique object) which is specified by the verb lemma. In this thesis I assume that functional assignment determines case marking; for example, in Japanese, case-marking determines the grammatical function of each noun. Thus the noun that is assigned the subject function is also assigned as the nominative case.

Further evidence of the assignment of grammatical roles at this level comes from an experimental study by Bock and Warren (1985). They suggest that the choice of grammatical assignment is affected by what Bock terms 'conceptual accessibility' (Bock & Warren 1985). Bock and Warren claim that conceptual accessibility influences grammatical function in two ways. Firstly, the ease of word retrieval from the mental lexicon influences grammatical function assignment, so lemmas which are retrieved faster will be assigned grammatical functions before lemmas which are retrieved less quickly. Secondly, grammatical functions are assigned by Keenan and Comrie's (1977) NP accessibility hierarchy, such that the subject functions are assigned first, direct objects second, then indirect objects and oblique objects. Thus the lemmas which are retrieved faster tend to be assigned as subjects, and less quickly retrieved

lemmas will be assigned as objects. This process determines the grammatical function of the sentence (e.g., active or passive). I will discuss this issue in detail in Chapter 3.

However, it is important to stress that ‘within grammatical encoding, there is no level of processing at which the element that serves as the subject of the sentence plays a role that can be realized as a different grammatical relation’ (Bock & Levelt, 1994). In other words, the argument which is assigned as, for instance, the direct object of the active sentence (*The BOAT in ‘Five people carried the boat’*) would not represent the (surface) subject of the passive sentence (*The BOAT was carried by five people*).

This claim is against some linguistic theories, such as transformational grammar (Chomsky, 1981). Such a theory predicts the existence of a deep structure, so that underlying objects may become surface subjects. However, strong evidence against this comes from an experimental study by Bock, Loebell and Morey (1992), who found no evidence of relation changing operations during grammatical encoding (I will discuss this issue further in chapter 4). In this thesis I take the view that once a grammatical role is assigned it should be maintained throughout grammatical encoding. Thus, it is assumed that the underlying roles and the surface roles are assigned during functional processing and positional processing (see Figure 3).

2.3.1.1. Speech errors

I will now clarify the details of functional assignment. Here, I will discuss the evidence for functional assignment that is provided by speech errors.

Bock and Levelt (1994) suggest that **Phrase (word) exchange** errors reflect failures of functional

assignment. Examples of phrase exchange errors are shown in (13) and (14) below (adopted from Garrett 1975);

(13) I have to fill up *the gas with car*. (intended: *the car with gas*).

(14) She donated *a library to the book*. (intended: *a book to the library*).

This type of error often occurs between the same class forms, and it happens within distinct phrases (Garrett, 1975). However there are two properties of exchange errors which suggest that they are not simple word exchanges.

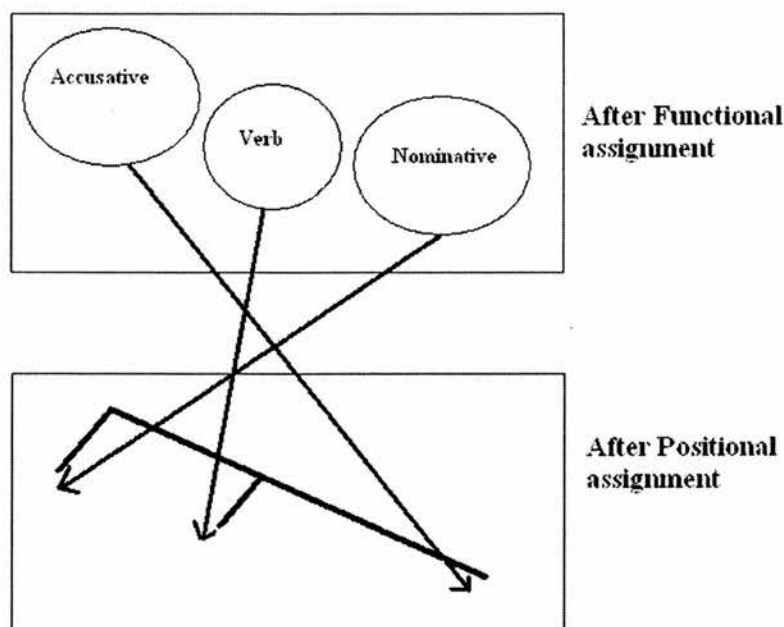


Figure 3: Figure 3 shows how the processing of grammatical functions (functional assignment) and grammatical relations (positional assignment) works (taken from Bock & Levelt, 1994). In this figure, the noun that is assigned the subject function is also assigned as the nominative case, and the noun assigned the object function is assigned as the accusative case, since it is assumed in this thesis that case-marking

determines the grammatical function of each noun.

The first evidence for this comes from the pronoun errors observed by Stemberger (1982)'s study. Stemberger showed an example (15) of pronoun errors in English:

(15) So, *you* must be too tight for *them* (intended: so, *they* must be too tight for *you*). (Stemberger, 1982: 329)

This type of error is restricted to the inversion of pronoun phrases in English, because only pronouns exhibit grammatical functions. The characteristic of this pronoun error is that both inverted pronouns take the appropriate case for the position they appear in, instead of keeping the case of the position they should have appeared in. As seen in the example above, the two pronouns (*you* and *they*) are in the wrong positions, but both pronouns have taken the appropriate case for the position they appear in. If this was a simple exchange it would have been '*you must be too tight for they*', where the nominative case pronoun *they* kept its case, rather than *them*.

Secondly, evidence for phrase exchange errors comes from subject-verb agreement. As the example below shows, the subject of the sentence is involved in the word exchange. The verbs in the error-bearing utterances tend to agree with the subject that is actually produced rather than with the subject that was intended. In this situation, the agreement of the verb has been matched with *you*, but not *that*. (Stemberger 1982).

(16) *That's supposed to hang onto you* (instead of *you're supposed to hang onto that*)

(17) *Most cities are true of that* (instead of *that's true of most cities*; (Stemberger, 1982))

Stemberger's (1985) corpus study revealed that this occurred in 6 of the 7 relevant errors. This suggests that the inverted phrase in the subject position in the error-bearing sentence also bears the role of subject during the process of verb agreement. In other words, these examples also show that when a lemma is retrieved from conceptual level its syntactic function has not been assigned yet, so then this information has to be dealt with at the functional assignment level.

In sum, this observation leads us to conclude that functional assignment involves assignment of syntactic properties to the retrieved lemmas.

2.3.1.2. Span of functional processing

In the previous section, the details of functional processing, which comprise lexical selection and functional assignment, were discussed. I will now look though the span (organization) of functional processing.

Some evidence, such as studies using experimental research (Bock & Cutting 1992) and research on hesitation and silent pauses (Holmes, 1988, 1995; Ford 1993), suggests that the span of functional processing is the clause. Strong evidence for this comes from an experimental study conducted by Bock and Cutting (1992). They investigated subject-verb agreement errors (also called attraction errors; Bock & Levelt, 1994) to see in which situations speakers produce most agreement errors. They compared clauses where the noun was embedded in a complex subject NP (clause NPs, example (18)) and sentences where only the head noun was available (PP modifiers, example (19));

(18) *The message that they expelled student(s) ...*

(19) *The message from the excited student(s) ...*

Bock and Cutting reported that their participants produced more errors with PP modifiers than with clause modifiers. Bock and Cutting claimed that this difference was due to the existence of the clause and clause boundaries delimit the specification of the verb agreement. In a clausal modifier condition such as (17), the local noun '*student(s)*' is in a separate clause from the main verb. If it is assumed that each clause belongs to a separate planning unit, the local noun '*student(s)*' cannot affect the agreement of the main verb. On the other hand, in the PP modifier condition such as in (18), the local noun '*student(s)*' is in the same clause as the main verb. Thus the local noun and the main verb are in the same planning unit and this could cause difficulty with subject-verb agreement since both are in the same unit and the local noun can influence the agreement of the main verb. Thus Bock and Cutting concluded that the span of functional processing is the clause.

From a different perspective, studies on hesitations and silent pauses (Holmes 1988, 1995) also give evidence of the span in functional processing. Holmes (1988) investigated filled pauses or hesitations (such as the phrases *um*, *er*), and silent pauses in natural speech. Holmes's analysis revealed that such pauses or hesitations were produced more at the beginning of sentences than within sentences, and also more at the beginning of clauses than within sentences. In addition, it was shown that longer silent pauses were produced before sentences than within sentences, and longer pauses before clauses than within clauses. Such results seem to indicate that finite and non-finite clauses cause this pausing.

In order to make sure that hesitations or pauses were not due to phonological prosodic planning, Holmes (1988) also conducted an experiment where participants were asked to read aloud some sentences which they had already produced in previous experiments. Holmes claimed that when people read aloud,

the text determines the content and structure of the sentence, thus if there are any silent pauses in reading aloud, that would be due to phonological and prosodic planning in production. This claim is supported by Henderson, Goldman-Eisler, and Skarbek (1965), who compared rates of producing silent pauses in the two situations, spontaneous speech and reading aloud. They found that more silent pauses were produced in spontaneous speech than in reading aloud. Henderson et al. (1965) claimed that at least some pauses in spontaneous speech may be for planning subsequent semantic and syntactic content. Thus, if the content or the structure of the sentence was responsible for hesitations, rather than the phonological or prosodic properties, participants should still have produced hesitant responses in reading aloud. Holmes found that in this experiment, her participants produced more silent pauses in finite clauses than in non-finite clauses. This suggested that the speaker's syntactic/semantic planning caused the pauses before non-finite clauses in spontaneous speech, and that this was not due to the speaker's phonological/prosodic planning. Thus, these results suggested that both finite and non-finite clauses were thought to be distinct units in speech production, and that both types of clause play an important role in language production.

There is also evidence that some aspects of an utterance are planned before speech onset. Smith and Wheeldon (1999) conducted a series of on-line picture description tasks and showed that when speakers described moving objects, latencies to complex-simple sentences (*The dog and the foot move above the kite.*) were significantly longer than to simple-complex sentences (*The dog moves above the foot and the kite.*). They found the same effect with double clause sentence (complex-simple: *the dog and the foot move up and the kite moves down*, vs. simple-complex: *the dog moves up and the foot and the kite move down*) and relative clause sentence (*the dog which is next to the kite moves up*). Such a difference of latencies indicates that grammatical encoding is not conducted for the whole of a sentence prior to speech onset, but only completed for the first phrase of an utterance (I will return to discuss Smith and Wheeldon's study more in section 2.4.2 and chapter 3 and 4).

In addition, Garrett (1980) reports from his corpus analysis that only 20% of word exchanges occurred across clause boundaries. Garrett suggested the importance of the clause as a planning unit, and proposed that two clauses might be the maximum that can be planned at any one time. However, it is not clear what level of processing (at a conceptual or grammatical level) these studies are informative about.

In sum, I have seen that functional processing involves two processes: retrieving lemmas from the mental lexicon, and grammatical function assignment. The output of functional processing is a structure that links lemmas and grammatical functions. I have also suggested that the span of functional processing is the clause. At this point, the items that are retrieved from the lexicon have not yet been ordered. The next level, positional processing, will deal with such constituent processing.

2.3.2. Positional processing – constituent assembly

Having identified the basic organisation of functional processing, in this section I will discuss the details of positional processing, which deals with constituent assembly and inflection. As output from the functional processing level, there is a message whose elements have undergone lexical selection and have been assigned grammatical functions (functional assignment). However this information has not been ordered, and the first process, called constituent assembly, will deal with this. Before articulating information, constituent assembly creates a hierarchy of phrasal constituents that manages a word order and captures dependencies among syntactic functions.

There are various types of studies showing the existence of a constituent assembly stage; these experiments use pausing or hesitation in speech (e.g., Cooper et al., 1978), speech errors (Garrett 1975, 1980), recall experiments (e.g., Johnson, 1965, 1966a,b) and other experimental methods (syntactic

priming, Bock, 1986a; Bock & Loebell 1990; Bock et al., 1992).

2.3.2.1. Pausing and hesitation

In the previous section, it was pointed out that pausing or hesitations in speech is a reflection of the mental processes of speech production. For instance, hesitations, silence, or filled pauses (*em, ah, um*) seem to reflect basic clause boundaries (Holmes 1988, 1995). In this section I will discuss how pausing and hesitations reflect the occurrence of constituent assembly.

As I discussed in p10, Cooper et al. (1978) conducted a series of experiments to investigate the effect of hesitations or pauses. Their participants read both a set of sentences and the intended meaning which were semantically ambiguous. Cooper et al. (1978) showed that participants took more time or produced longer pauses to read the word '*naturally*' in *My Uncle Abraham presented his talk naturally* when the intended meaning of the sentence was *Of course Abraham presented his talk* rather than *Abraham presented his talk in a natural way*. Cooper et al. (1978) concluded that long pauses occurred more when the modifier *naturally* as in *...presented his talk naturally* was in a different constituent from the item it was modifying than within the same constituent as in *... his talk in a natural way*, and thus constituent boundaries were key factors determining lengthening and pausing.

2.3.2.2. Speech errors

There are some speech errors that may reflect the problems of positional processing. These are called sound exchanges or spoonerisms:

(20) ... *teep a cape* (intended: *keep a tape*)

The linear order of the intended sounds is switched, such as *teep-keep* or *cape-tape*. Usually when a sound exchange occurs it keeps the same articulatory pattern, such as repeating similar phonemes, or preserving the syllable position and stress patterns (Garrett, 1975). Additionally, sound errors usually occur between adjacent syllables and words of the same phrase. Garrett's (1980) data shows that 87% of sound exchange errors happen in the same phrase. Such examples strongly suggest that the sound structure for an utterance occurs in a phrase-by phrase fashion.

2.3.2.3. Experiment research - Recall tasks

Experimental studies such as those using sentence recall tasks show that speakers organize the information of phrasal constituents during constituent assembly. Johnson (1965) conducted a recall experiment in which participants were asked to recall some sentences they had heard;

(21) a. *The tall boy saved the dying woman.*

b. *The shoes with red bows were sold.*

Johnson hypothesised that if speakers organize information in terms of phrasal constituents, they should produce more errors when recalling a word when it involves a transition from one phrasal constituent to the next than when it is within the same phrasal constituent as the end of the sentence. For instance in (21a), such an error should occur between the third and fourth word (at this point it requires a phrasal transition), and in (21b) it should occur between the second and third, and between the fifth and sixth words.

Johnson confirmed that participants produced more sound exchange errors when the word was within a phrasal transition than within the same phrase. He concluded that speakers' information is structured in functional units which correspond to phrase-structure rules. However, Bock and Levelt (1994) suggest that Johnson's study did not say anything about the information that is encoded or elaborated in frames or about the processes that create them. The next section, experimental research, investigates this issue furthermore.

2.3.2.4. Experimental research – priming tasks

Experimental studies which demonstrate syntactic priming also provide evidence of the existence of constituent structure (e.g., Bock, 1986a; Bock & Loebell 1990; Bock, Loebell & Morey. 1992). Bock (1986a) focused on the fact that during conversations speakers sometimes produce the same syntactic structures repetitively. This phenomenon may reflect the priming of syntactic structure, and Bock conducted a series of experiments to investigate this effect. In her experiments, participants listened to and repeated prime sentences and described target pictures orally. Although sentences and pictures in the trials were semantically unrelated, it was possible for participants to describe the pictures with the same syntactic forms as those used in the prime. Bock found that participants produced more Prepositional object (PO) target descriptions (*The doctor gave the injection to the patient*) after PO prime sentences (e.g. *A rock star sold some cocaine to an undercover agent*) than after Double object (DO) prime sentences (e.g. *A rock star sold an undercover agent some cocaine*). She also found that they produced more active target descriptions (*Lightning is striking the church*) after active prime sentences (*One of the fans punched the referee*) than after passive prime sentences (*The referee was punched by one of the fans*) and vice versa. Bock et al. (1992) found similar priming effects with active and passives; her participants were more likely to describe the pictures with passive forms (e.g., *The alarm waking the boy* as *The boy was*

woken by the alarm) after repeating passive sentences (e.g. *The referee was punched by one of the fans*) then after actives (e.g., *One of the fans punched the referee*).

In order to investigate this priming effect further, Bock and Loebell (1990) ran similar priming experiments to rule out the possibility that the priming effect was due to conceptual similarity between the prime and target sentences. For instance, Bock and Loebell found that a locative sentence such as '*The 747 was alerted by control tower*' was as effective a passive prime as '*The 747 was landed by the control tower*' even though it has the conceptual dissimilarities between the two sentences, which means that the locatives had agents as subjects, while the passives had patients as subjects. In addition to this, Bock and Loebell compared two sentences which had different constituent structures but comparable phonology and positioning of the closed-class words. For example, while '*Stella brought a book to Susan*' and '*Stella brought a book to study*' are similar in terms of the subject noun phrase, metrical structure, in phonology and position of closed-class word '*to*', they differ in constituent structure. Bock and Loebell found that a picture depicting *A girl handing a paintbrush to a boy* could only be primed by the former example but not the latter. In sum, these results led Bock and Loebell to conclude that syntactic priming was not due to the repetition of thematic roles, and that priming happened even when prime and target sentences did not share the conceptual similarities (defined by event role), such as the thematic interpretation of the by-phrase.

2.3.3. Positional processing – Inflection

Inflection is another step in positional processing. At this point the information such as tense, aspect and number is already decided, but it has not been realised in the morphology yet. Evidence of inflectional processing at the positional level comes from speech errors (Garrett 1975, 1980;

Garcia-Albea et al., 1989) and neuro-psychological studies (Saffran, Schwartz & Marin, 1980).

2.3.3.1. Speech errors

As I have seen in a previous section, two types of speech errors, *strandings* and *shifts*, reflect the failure of inflection at the positional level. To recall, stranding is an error involving free form exchange. The elements that are exchanged are almost free forms, but the elements that are left behind are bound morphemes which are left in the original position. Shift errors are also thought to arise during the process of inflection. A shift error is the misplacement of bound morphemes (*he gets it done – get its done* (Garrett, 1975). Such errors suggest that the assignment of grammatical functions has been correctly processed, but that the inflection has been wrongly assigned. Such observations lead us to conclude that inflections are independently processed during the positional level.

2.3.3.2. Neuropsychological studies

Evidence of inflectional processes at the positional level also comes from neuropsychological studies. Saffran et al. (1980) analyzed the speech errors of agrammatic aphasic patients, who have difficulty in constructing grammatically complete sentences. Saffran et al. (1980) reported that their patients had the tendency to omit verbs and other syntactic elements, or to place them with incorrect grammatical morphemes (such as *-ed* or *-ing*). For example, the verbs that their patients produced either missed the inflection such as person or tense (example 22a, b), or they tended to produce the gerundive using the participle (*-ing*) (example 23, all from Saffran et al. 1980: 231).

(22) a. *The guy wash the boy.*

b. *The girl study.*

(23) *The guy smiling.*

On the other hand, Saffran et al.'s (1980) patients were able to produce other grammatical morphemes. For instance, they had no problem with producing plural inflections (e.g., *cars*). This observation led Saffran et al. (1980) to conclude that particular aspects of syntactic processing could be impaired.

To sum up, positional processing creates a constituent hierarchy which determines the order of constituents and the dependencies among the syntactic structures. It also involves the process of inflection, where information such as number, tense and aspect is assigned to words.

2.4. Information Flow

In the preceding sections, I have identified the different components of the language production system. In this section I will discuss the information flow between them and in particular whether information from one component can directly affect processing in another. In particular, this session will review two aspects of the information flow; the flow between two stages of lexical access, and the influence of phonological encoding on functional assignment.

2.4.1. Information flow in lexical access

In the previous section, 2.2.1, I discussed how lexical access has two separate stages, lemmas and word-forms. In this section I will focus on the feedback occurring during lexical access, that is, if there is

any feedback from lower stage to the upper stage. In other words, I will review whether it is a feed-forward processing system or whether there is more interactive processing between different levels of lexical access.

Dell and Reich (1981) assume that lemma retrieval takes place at the functional level and that word-form retrieval takes place at the positional level. Dell and Reich analyzed speech errors to examine if the functional level affects processing at the positional level, and also the opposite: if the positional level affects the functional level.

In the previous section (2.1), I looked at speech errors, such as *semantic substitutions* and *blends*, which occur at the lemma level. Using these error examples, Dell and Reich (1981) investigated the phonological similarity of these two types of errors in order to explore whether the functional stage has an influence on the positional level. If there is no feedback effect from phonological encoding to the functional level, there should not be phonological similarities in semantic substitutions and blend errors. However, if there is some feedback between the functional and positional levels, there should be some phonological similarities. Dell and Reich's analysis showed clear phonological similarities between words involved in both semantic substitutions and blends. Thus they concluded that phonological processing affects lexical selection.

In addition to this, Dell and Reich analyzed the likelihood of a sound error being produced as a word or a non-word. They observed that sound errors most often produced words instead of non-words, indicating that there may be some feedback between the mental lexicon and the phonological level, which then influences the speaker's output. Thus they suggested that the positional level influences the information at the functional level.

Del Viso et al. (1991) conducted a slip-of-the-tongue analysis in Spanish, in order to examine firstly, phonological contaminations of semantic substitutions, and secondly, semantic contaminations of phonological substitutions. Although they did not find any semantic relationships within phonological substitution errors, Del Viso et al. (1991) found that semantic substitution errors shared some phonological properties with the intended output, such as word lengths or stress features. They explained that this was because even from an early stage of production, lexical retrieval was somehow sensitive to the metrical and intonational structures of phrases. In spite of the phonological effects they found on semantic substitution errors, then, they claimed that their results supported the view that there is no phonological influence on lexical selection at the functional level.

Dell (1986) and Dell and O'Seaghdha (1992, see also Dell & Reich, 1981) proposed a 'spreading activation model' to explain phonological influences on lexical selection (e.g., semantic substitutions and blend errors); in other words, how the network 'shares' semantic and phonological properties (see Figure 4). In this network, each node has several linguistic units, such as conceptual units, lemma or word units and phonological units. First of all, an unspecified conceptual representation activates the semantic nodes, and it goes throughout the lexicon and activates semantically and phonologically related words. In this sense, if a word is semantically and phonologically very close to the intended word, it is likely that its activation would be high, with the result that the speaker may produce this word. For instance, when a speaker has accessed the word *cat*, semantically related words are also activated, such as *dog* and *rat*. But phonologically similar words like *mat* are also activated, since they share the similar phonological properties. In addition, since semantically related words like *dog* are activated, words such as *log* are also activated because these words share phonological similarities. Moreover, when both words share semantic and phonological similarities (such as *rat* and *cat*), these are also activated. However in this example, the activation of *rat* will be even more likely than in the previous examples, since *rat* is both semantically and

phonologically similar to *cat*, while words such as *dog* or *mat* only share one type of similarity (*dog* shares semantic similarity, *mat* shares phonological similarity). In addition to this, Dell (1986) and Dell and O'Seaghdha (1992) propose that a spreading activation network can interact between the different stages, and this gives a better explanation for certain speech errors, such as semantic, phonological and mixed word substitution errors.

In sum, it is still questionable whether there is feedback or just feedforward information in lexical access (see Dell & O'Seaghdha 1991; Levelt et al., 1991b for a discussion). Since it is not the main issue in this thesis, I will not discuss this further, however I will take the position that there are two stages of lexical access, and there is no feedback from lower to higher stages.

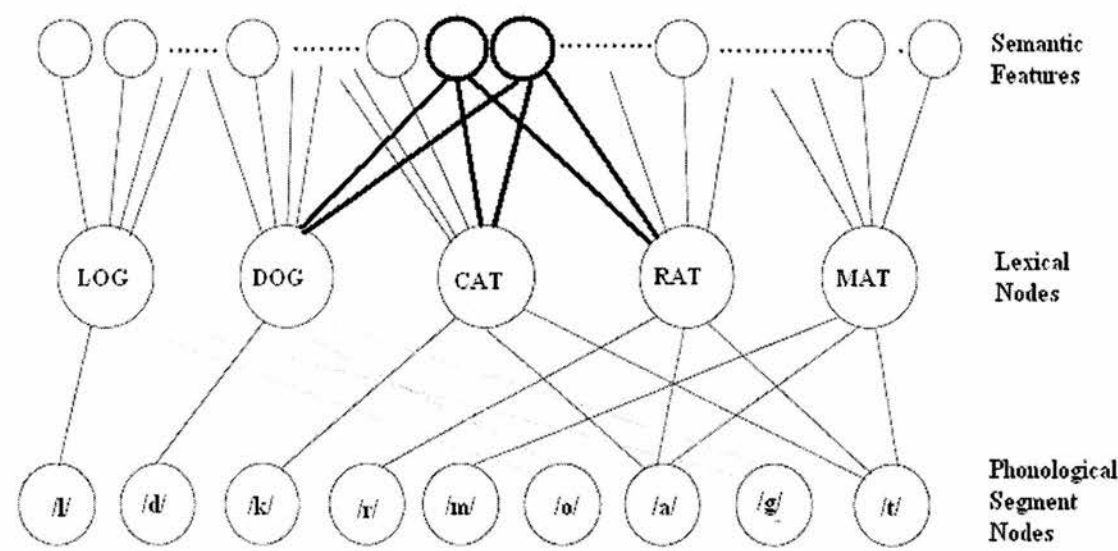


Figure 4 shows a spreading activation model (adapted from Dell 1986; Dell & O'Seaghdha (1992))

2.4.2. Information flow in the production system

The previous section reviewed whether there is any feedback during lexical access. In this section I will examine whether there is a feedback system within grammatical encoding; that is, whether some features at the positional level can influence what happens at the functional level. In particular, I will look at the effect of the retrieval of the phonological form of a word on its functional assignment. This section also examines the relationship between the functional and positional levels, in other words, whether the information at the functional level has to be completely specified before it passes to the positional level, or whether the two levels are somehow parallel.

First of all, I will examine whether there is an effect of information flow from lower levels (positional level) to higher levels (functional level). Bock (1986b) and Bock (1987b) investigated the influence of phonological accessibility to higher level. Once again, note that Bock (1987b) accepts Garrett's model of language production (Garrett, 1975, 1980, 1982), where the phonological specifications of words are formed at the positional level. However, more recent models (Bock & Levelt, 1994; Levelt, 1989; Levelt et al., 1999), which I assume in this thesis, predict that the positional level does not contain such phonological information.

Thus, Bock predicted that if the process of grammatical function is a top-down system (functional level to positional level), then phonological information should not influence the functional level and syntactic structure. Or alternatively, if there *is* information flow from the positional level to the functional level, phonological information should influence syntactic structure. In other words, phonologically more accessible words should tend to precede less phonologically accessible words, resulting in the accessible words being placed at earlier sentential positions, or having shorter onset speech latencies. Thus the

relative accessibility of word-forms may influence word order variation.

First of all, Bock (1986b) investigated if the accessibility of the semantic and phonological forms of words influence the syntactic structure. She asked participants to describe pictures such as 'lightning striking a church', with their descriptions preceded by uttering prime words. These primes were semantically or phonologically related, such as '*thunder*' (semantically related to lightning), '*worship*' (semantically related to church), '*frightening*' (phonologically related to lightning) and '*search*' (phonologically related to church). Bock found that semantically primed elements tended to be the subjects of the active and passive sentences in the target descriptions (e.g., *Lightning is striking the church* or *The church is being struck by lightning*). However, Bock also found that the phonological primes did not influence the choice of word order in the target descriptions. Thus, Bock suggested that, while semantic accessibility could affect the choice of grammatical functions, phonological accessibility did not influence the assignment of grammatical roles. Therefore, Bock concluded that there may not be any feedback from phonological processing to grammatical processing.

However, Bock (1987b) did find the phonological accessibility on grammatical functions. Bock examined these issues and conducted several experiments to investigate if there is a phonological priming effect during sentence formulation. She used a picture description task, in which participants articulated a word and described a picture orally, and the word was phonologically related to the picture which was presented. Bock presented two types of pictures to the participants: pictures that could be described with transitive descriptions (active or passive, (24)) and pictures that could elicit sentences including phrasal conjuncts (25). For example, if the picture was (25), then the priming word could be either *lamb* or *plant*;

(24) *a bee stinging a man on the arm*

(25) *a woman carrying a lamp and a plant*

According to Bock, a word which is phonologically similar to a prime should cause some interference (an inhibition effect) if participants realised the phonological similarity. Thus the prediction would be that phonologically unprimed words should be more accessible than phonologically primed words, with the result that unprimed words should precede primed words in sentences.

Bock's results showed that phonologically unprimed words tended to precede phonologically primed words. She also confirmed that this phenomenon was not related to the change of syntactic structure (e.g., active and passive) or word orders within phrasal conjuncts. Bock concluded that such results indicated phonological influences on syntactic processing in language production (see Levelt & Maassen, 1981), who found a similar effect; that difficulty of lexical retrieval affects the revision of the syntactic structure). It is important to stress that Bock (1987b) and Levelt and Maassen (1981) still support a model which stipulates two levels of processing in production. However, they argued that there should be some sort of information flow from one level to another, and that there would be the possibility of feedback from the positional level to the functional level.

There are some conflicts between the results of Bock's (1987b) and Bock's (1986b) experiment. Although Bock (1986b) examined the effects of phonological accessibility, her experiment did *not* show that early positioning in a sentence was influenced by phonological accessibility. Bock (1987b) herself explained that since the manipulation in her 1986b experiment was not strong enough, it did not show such phonological effects. However, McDonald et al. (1993) conducted sentence recall experiments and investigated the influence of word-form accessibility in phrasal conjunct. They tested the different stress pattern, trochaic disyllables (creating conjunctions with a STRONG-weak-STRONG-weak pattern, such as *doll and attic*) and iambic disyllables (a weak-STRONG-weak-STRONG pattern, such as *antique and doll*). They did not find that such a stress pattern influenced the order of phrasal conjunct. Thus,

McDonald et al. (1993) concluded that word-form accessibility does not influence word order. Hence, it is difficult to determine what causes this phonological effect.

However, there are two possible explanations for Bock's results. The first one is, as Bock claimed, that there may be feedback effects between the functional level and the positional level. According to Bock, in general speakers tend to describe transitive events using active forms. However, if there were some difficulties in producing the phonological form of the subject noun, there should be some disruptions evident, such as hesitations or filled pauses. In order to solve these processing problems it is possible to change the syntactic form, by placing more accessible words earlier than less accessible ones. Thus Bock claims that lexical or syntactic difficulty at the positional level should cause a revision at the functional level.

It is also possible that such an effect could be a result of the monitoring system (de Smedt and Kempen, 1987; Levelt, 1989; Levelt et al., 1999). The model proposed by de Smedt and Kempen does not allow any feedback from the bottom level to the top. They suggest that all effects of later stages of processing on earlier stages of processing are a result of the monitoring system. The monitoring system predicts that, as soon as an error is detected, the ongoing processing will be interrupted and the processor will try to backtrack to the previous level in the production system. Thus, in this sense, trouble at the positional level will prompt backtracking to the functional level and hence the effects of the positional level upon the functional level will only be indirect (see Levelt, 1989 for more details about self-monitoring).

Thus, it is difficult to conclude that there is a phonological influence on the positional level. It is generally assumed that information flow is strictly top-down, and there is no feedback from lower to higher levels of processing in production (Bock 1987a; Levelt 1989; Bock & Levelt 1994). I will adopt



this top-down model in this thesis.

Another question relates to the process between the functional and positional levels. Here there are two possibilities; either the information at the functional level has to be completely specified before it reaches the positional level, or the two levels run in parallel, where some information at the functional level passes to the positional stage while functional processing is still in progress.

Many researchers argue that the production system is designed to be as quick and fluent as possible (e.g., Bock & Levelt, 1994; Levelt, 1989). Thus it has been suggested that as soon as some information is available, the processor will allow this information to pass to the next level. Many researchers suggest that the production system is highly incremental (e.g., Kempen & Hoenkamp 1987; de Smedt & Kempen 1987; Levelt 1989; Bock & Levelt, 1994, for more discussion see chapter 3), so that processors do not need to wait until the next information is available before working on the current information. Strong evidence for this comes from studies by Lindsley (1975) and Smith and Wheeldon (1999). First of all, Lindsley investigated how long his participants took to initiate sentences with a Subject-Verb order (SV), and a Subject-Verb-Object order (SVO). Lindsley did not find a time difference in the initiation of SV and SVO sentences, and claimed that the length of a sentence does not determine the time it takes to initiate it, supporting the claim of incremental processing.

Secondly, Smith and Wheeldon (1999) ran a series of on-line picture description tasks to determine latencies with a wide variety of sentences. They tested two types of sentences in moving object descriptions, complex-simple (*The dog and the foot move above the kite.*) and simple-complex (*The dog moves above the foot and the kite.*) and measured the speech onset time. They found that latencies to complex-simple sentences were significantly longer than to simple-complex sentences. They found the

same effect with double clause sentence (complex-simple: *the dog and the foot move up and the kite moves down*, vs. simple-complex: *the dog moves up and the foot and the kite move down*) and relative clause sentence (*the dog which is next to the kite moves up*). Such a difference of latencies indicates that grammatical encoding is completed for the first phrase of an utterance but not completed for the while of the first clause of an utterance prior to speech onset. This also suggests that speakers do not wait until all the information is available, instead processors go through the next stage as long as the minimal amount of information is formulated. This also supports the claims of incremental processing (I will return to discuss Smith and Wheeldon's study in chapter 3 and 4).

Contrast to such a view, Pickering, Branigan and McLean (2002) claimed that grammatical encoding could take place in one stage. They conducted a series of written sentence completion experiments and compared PO (e.g., *The racing driver showed the extremely dirty and badly torn overall to the mechanic*), DO (e.g., *The racing driver showed the mechanic the extremely dirty and badly torn overall*) and 'shifted' prime sentences (e.g., *The racing driver showed to the mechanic the extremely dirty and badly torn overall*). They found that 'shifted' primes did not prime PO completions of target sentences, relative to an intransitive baseline prime. Since shifted responses were very rare responses, speakers were likely to produce PO responses for the target descriptions. Pickering et al. (2002) did not find more PO responses following shifted primes than following intransitives. Therefore, they argued that such results supported a single-stage account, suggesting that all three structures are represented at a single level (see page 119 in chapter 4 for more discussion).

Models of incremental processes in production are also proposed by de Smedt and Kempen (1987) (also de Smedt, 1990; Kempen & Hoenkamp, 1987; Levelt, 1989) and Bock and Levelt (1994). In both models by de Smedt and Kempen and Bock and Levelt, each stage can deal with information

independently and in parallel. After the conceptual level receives information, it will pass it on to the next level (lexico-syntactic level) quickly, and the conceptual level will deal with another chunk of information at the same time. The difference between de Smedt and Kempen's and Bock and Levelt's models is that de Smedt and Kempen propose a cascading process of language production, where information at higher level passes immediately onto the next lower level in a cascading fashion, whereas Bock and Levelt propose a non-cascading parallel model, where information at the lemma level will not get passed to the word-form level until the processing at the lemma level has been completed, and a single lemma has been selected. However, the processor itself runs in parallel, in that processing can simultaneously take place at the lemma and word-form levels.

However, the important point here is that neither model allows any feedback from the bottom level to the top. Thus, as I discussed earlier, they suggest that all effects of later stages of processing on earlier stages of processing must be a result of the monitoring system (de Smedt & Kempen, 1987), which predicts that, as soon as an error is detected, the ongoing processing will be interrupted and the processor will try to backtrack to the previous level in the production system (see Levelt, 1989 for more details about self-monitoring).

In sum, it is assumed that the information flow passes from higher levels to lower levels, and that feedback from the bottom to the top level is not allowed in current models of production (e.g., Bock 1987a; Levelt 1989; Bock & Levelt 1994). It is also claimed that production is highly incremental, so that as soon as the information at one stage is available, it passes onto the next level. This view also argues that production is a top-down process.

2.5. The mechanism of production: The coordination problem

Overall, the previous sections have reviewed the basic assumptions of the mechanisms of language production; primarily, that the production model is divided into three different levels. In addition, the information flow from higher levels to lower levels has been reviewed (also I have seen the possibilities of the feedback of information flow). Moreover, I have discussed an incremental account of language production, which suggests that information passes from one stage to another as soon as the information is partially formulated.

The main question in this thesis regards the formation of syntactic structures in language production. During natural conversation, speakers have to produce well-formed utterances. Converting speakers' thoughts into the appropriate words with the appropriate structures requires the complex mapping of semantically specified words (lemmas) into syntactic structures. Such a complex mapping process (from lemmas to syntactic processing) has been called the coordination problem (Bock 1987a).

The following section will review two different approaches to the mapping process in language production. The first view is based on psycholinguistic experiments (e.g., Bock 1987a; Bock & Levelt 1994), and the second one is from computational approaches (de Smedt, 1990, 1994, 1996).

2.5.1. A psycholinguistic approach

As seen previously, many studies such as Bock (1987a, 1995) and Bock and Levelt (1994) suggest that grammatical encoding involves both functional and positional levels. According to empirical research, it is assumed that at the functional level, lemmas are retrieved from the mental lexicon and these are

assigned grammatical functions (such as subject or direct object). On the other hand, the positional level determines the serial word order. Questions therefore arise about the processes of functional integration (how grammatical functions are mapped onto lemmas) and constituent integration (how words are combined in a syntactic structure).

First of all I will review functional integration. Several studies (Bock & Warren, 1985; Bock 1987a) claim that the choice of grammatical assignment relates to the accessibility of lemmas. In addition to this, different verb forms will be activated during functional integration, such as active and passive forms. These different verb forms are assumed to have different strengths. Thus, how functional integration is resolved will depend on, firstly, the accessibility of the lemmas, and secondly, the strength of the different verb forms. As I discussed above, highly activated concepts will be associated with the message, and verb forms will be associated with the way participants tend to construct sentences (such as active or passive, SOV or OSV). So in this sense there are two possibilities; higher grammatical functions will be activated faster than lower grammatical functions, and/or actives will be activated faster than passives (this may not be universally true). If the agent of a transitive action is retrieved most quickly it is likely that the agent will be assigned as the subject of an active sentence. If the patient of transitive action is retrieved most quickly, it is likely that the patient will be assigned as the subject of a passive sentence. So there is competition between the accessibility of lemmas and the strength of verb forms; because active forms are usually (in English at least) much stronger than passive forms, this will result in a strong preference for active forms to be chosen more than passive forms.

Secondly I will review constituent integration, which basically determines the serial word order in production. Bock (1987b) suggests that the accessibility of word-forms should influence constituent integration, where phonologically more accessible words should be placed in earlier positions during

sentence integration. However, there are several problems with Bock's feedback account. For instance, Bock's phonological priming effect was 'inhibitory' such that phonologically primed words tended to come last (e.g., *lamb* for *The woman is carrying the plant and the lamp*). Levelt (1989) claims that although Bock's result can be explained by the feedback account from phonological encoding to syntactic encoding, it is also compatible with an account in which a speaker fails to access the phonological form of a word, then syntactic structure is revised. This could be tied with the fact that there were more disfluencies when the early target words were phonologically primed. Levelt suggests this moment is exactly when syntactic revision is taking place. Thus, it is hard to interpret Bock's result as evidence that word-form accessibility influences constituent integration (cf. Levelt & Maassen, 1981, see Levelt 1989 pp. 279-281 for discussion).

It has also been suggested that the accessibility of lemmas is not sensitive to word order variation (e.g., Bock & Warren, 1985). However, in other languages, grammatical function assignments do not always determine word order. As I have seen in the introduction section, in Japanese case marking determines the word order. Thus even if the grammatical function is determined (such as nominative, accusative) at a given point, the actual word order will not have been decided yet. Thus, in relatively free word order languages, a highly accessible lemma in an object position could be retrieved faster than one in a subject position (Branigan & Feleki, 1999; Kempen & Harbusch, 2004; Prat-Sala & Branigan, 2000; Tanaka et al., 2005). In this sense, the relative accessibility of lemmas may influence positional processing (along with the impact made by the syntactic flexibility of language). This will be discussed more in chapter 3.

In sum, the functional level seems to be influenced by the activation of lemmas and the syntactic roles that lemmas take. The positional level is driven by the syntactic flexibility of language and possibly the accessibility of lemmas as well.

2.5.2. A Computational Approach

In this section I will review a computational view of language production (in computational linguists' terms it is also called 'language generation') which was put forward by Kempen and Hoenkamp (1987), and de Smedt (1990, 1994, 1996). As previously suggested, it is important to stress that although this model is based on a computational view, it is also proposed to be psycholinguistically realistic. The computational model of language production is called the Incremental Parallel Formulator (IPF). De Smedt (1990, see also Kempen, 1987) proposes the structure of *Syntactic Segments* (also called Segment Grammar) which represent one immediate dominance (ID) relation. Figure 4 shows a representation of this model. According to De Smedt (1990), Syntactic Segments are the elementary building blocks of the grammar, shown as a box in Figure 5. These segments are graphed into two nodes, a root and a foot node. Isolated segments are vertically represented with the root node, labelled with its category at the top (NP), the foot node, labelled with its category at the bottom (NOUN). An arc represents as a vertically directed edge labelled with a grammatical function (head) between two nodes. In Figure 5, segments are also written left-to-right (root-to-foot), such as S-subject-NP or NP-head-NOUN.

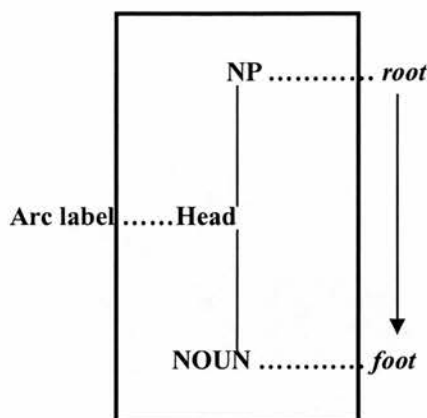
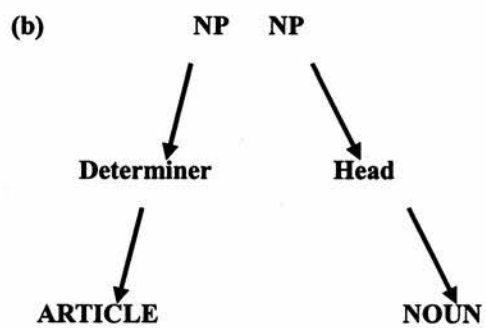
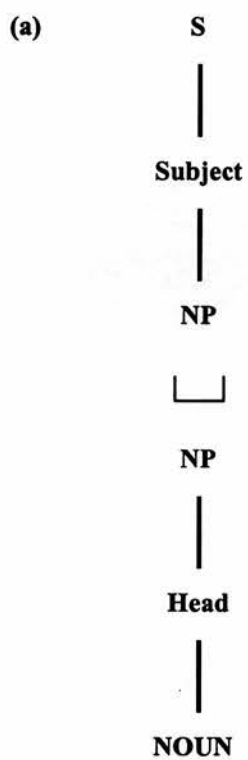


Figure 5. A syntactic segment (taken from de Smedt, 1990)

Syntactic structures are formed by, using de Smedt's term, the 'local unification of nodes'. In this operation, there are two basic variants of unification: *concatenation* (vertical composition by unifying a root and a foot) and *furcation* (horizontal composition by unifying two roots). For instance, two segments which are instances of S-Subject-NP and of NP-head-NOUN can be *concatenated* by unifying their NP nodes (as in (a) in Figure 6); two segment which are instances of NP-determiner-ARTICLE and NP-head-NOUN can be *furcated*, also by unification of their NP nodes (as in (b) in Figure 6). Agreement (or unification) comes from specifying which features are shared between the root and the foot of a concatenated and furcated segment. For example, the features NUMBER and PERSON are shared in S-SUBJECT-NP as well as in S-HEAD-FINITE-VERB. If such segments are furcated by unifying their S nodes, the shared features in both segments are unified, as depicted in Figure 6 (c). .



(c)

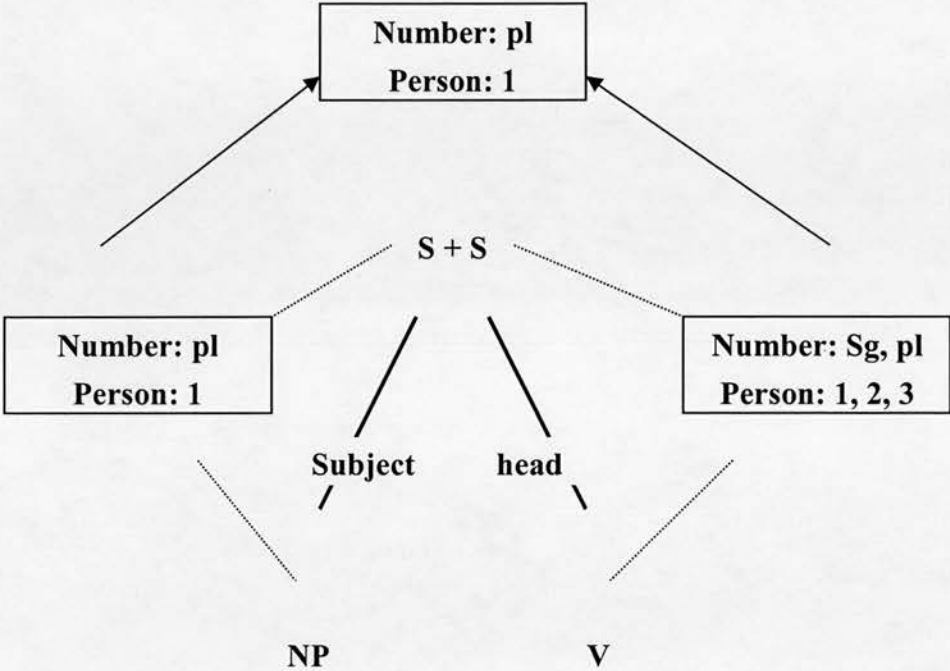


Figure 6: The structure of syntactic segments, adapted from de Smedt (1990). (a) represents concatenation and (b) represents furcation. (c) represents agreement by means of feature sharing (taken from De Smedt, 1990)

During formulation, the grammatical encoder will create f-structures (also called functional-structures). F-structures are responsible for encoding elements such as lexical elements, and syntactic relations and syntactic features are also incrementally encoded at this stage. It is important to note that the subcategorization of properties of lexical items is determined here. This is because sentences with similar conceptual representations such as (26)-a and (26)-b could result in different syntactic structures due to the differing syntactic subcategorization of 'know' and 'want'. However, constructing the syntactic structures first, before the correct lexical items are chosen, would lead to ungrammaticality, as in (26)-c. Thus generation is conceptually and lexically driven, depending on the meaning to be expressed;

(26)

a. *John knew he hit Peter.*

b. *John wanted to hit Peter.*

c. **John wanted he hit Peter.* (de Smedt, 1990)

On the other hand, retrieved lexical items are also categorically restricted by the syntactic structure. For instance, as in (26)-b, if the verb 'hit' is chosen first, the subsequent lexicalization of its direct object will be limited to an NP. Thus, in this sense generation is also partially syntax-driven.

However, f-structures only decide immediate dominance (ID) relations, but do not decide the left-to-right order of constituents. The order of constituents is decided by c-structures (constituent structures). C-structures are incrementally retrieved from f-structures; they contain information such as syntactically specified words, and represent linear precedence (LP) relations. It is worth mentioning that this distinction between F-structures and C-structures corresponds to the distinction between functional and positional processing in psycholinguistic models of language production (e.g., Bock & Levelt, 1994, Garrett, 1980).

A lexical segment is a segment where the foot is a word. The representation of lexical entries as lexical segments contains two separate types of information; the root of a lexical segment contains syntactic/semantic information (lemmas) and the foot contains morpho-phonological information (the word-form) (e.g., NP-head-*boat* is a nominal lexical entry and S-head-*carry* is a verbal lexical entry). Semantic elements of words are associated with the root of the segment, and thus the segment is accessed through the root in generation.

A *case frame* provides the relationship between semantic concepts and syntactic structures. It assigns syntactic roles to particular participants in the situation represented by the sentence and it is attached to the roots of lexical segments, rather than to the feet.

Left to right positioning is determined in a bottom-up fashion. The foot node of a segment is attached to the C-structure under the destination. The F-structure decides the destination of a constituent.

For example, the destination of the foot node *man* in the nominal lexical segment NP-head-*man* will be determined by the destinations of the root node NP. The destination will depend on what kind of function that constituent plays at the f-structure (such as subject or object). Each phrase is associated with slots (called *holders*). However the foot node has the feature positions of the segment, so it is attached to the destination in the C-structure. Each segment includes a feature position so that it can list the possible positions where that segment can appear in the sentence. Such possibilities are language-specific and decide word order.

IPF assumes that F-structures and C-structures are constructed incrementally, hence the choice of word order is also incrementally decided. When the system creates the order of constituents, constituents will try to fill in the first slot available. For instance, in Japanese, there are two different word orders available, SOV (27a) and OSV (27b). Thus the subject can be placed at the first or second position before the verb. This means that the foot of an S-Subject-NP segment can go to the first slot (holder) or third slot. The default preference is to place it in the first slot, producing an SOV order (27-a). However, if the first slot is already filled with another constituent, then the foot will be placed in the third slot, causing a different word order in Japanese (27-b).

(27)

a. SOV in Japanese

5 人の人がボートを運んだ。

Gonin no hito ga booto o hakon-da.

Five people NOM boat ACC carry-PAST

'Five people carried the boat.'

b. OSV in Japanese

ボートを 5 人の人が運んだ。

Booto o Gonin no hito ga hakon-da.

Boat ACC Five people NOM carry-PAST

'Five people carried the boat.'

The IPF predicts that pragmatic notions such as discourse topics may also be closely associated with word order. The conceptual accessibility hypothesis (Bock & Warren, 1985) is related to such pragmatic notions. The IPF proposes that entities which are discourse topics are conceptually more accessible than other entities, and hence such entities tend to be at earlier positions in sentences. It is also possible that passivization can be produced by conceptual accessibility when the patient of the sentence is conceptually accessible. Thus, de Smedt predicts that passivization can occur because a possible direct object was placed at the beginning of the sentence, resulting in it becoming the subject of the sentence. However, de Smedt points out that other factors, such as rhetorical effects, can also affect word order. However, he argues that such factors are imposed by the order in which conceptual elements enter the formulator.

Overall, in contrast with the psycholinguistic approach, the computational approach proposes that

information at the functional and positional levels can be processed in parallel, and meanwhile different information can be computed at each level at a particular time. Conceptual elements are attached to syntactic fragments which represent ID relations. Moreover, within the formulator, IPF allows different branches of a syntactic structure to be computed in parallel. In this model, as there is not a particular order in which conceptual elements enter the formulator, a direct object NP can be created before a subject NP. As seen previously, computational models of language production can provide some useful insights into the architecture of language production, and they are proposed to be compatible with psycholinguistic processing. However in this thesis I will focus on psycholinguistic models of language production.

2.6. Summary

In sum, I have reviewed the current model of language production in general. It has three different stages: Conceptualization, Formulation, and Articulation. Formulation is divided into two stages, Grammatical encoding and Phonological encoding. Grammatical encoding is further divided into two processing stages, functional processing and positional processing. Functional processing involves lemma retrieval from the mental lexicon and grammatical function assignment (e.g., subject, direct object). During positional processing, word-forms are retrieved and constituent assembly and inflection are also processed. Lexical access has two stages, the lemma level at the functional level and the word-form level at the phonological level. Grammatical encoding has a further two stages: functional processing and positional processing. There is some evidence which demonstrates that information flow can occur from lower levels to higher levels, but the majority of studies do not support this, supporting only information flow from higher levels to lower levels. Finally, there are two main views of syntactic formulation and word order construction, one based in psycholinguistics, and another based on computational models.

Chapter 3

Animacy and syntax

3.0. Overview

In this chapter, I will examine how conceptual factors such as animacy influence syntactic processing in language production in general. More specifically, I will examine how animacy can contribute to the choice of grammatical function assignment and word order in language production. First of all, I will outline theoretical linguistic research on ‘animacy effects’ on language, then review psycholinguistic research on animacy effects. In this thesis, I will take a psycholinguistic approach, focusing on language production. Empirical studies suggest that there are three possible influences of animacy on syntax in language production. One possibility is that animacy affects grammatical function assignment only, with animate entities being assigned higher grammatical functions than inanimate entities (e.g., Bock & Warren, 1985; Bock, Loebell & Morey, 1992; McDonald et al., 1993). Alternatively, animacy might influence word order (with animate entities appearing in early word order positions in flexible-order languages; Branigan & Feleki, (1999, Greek); Prat-Sala & Branigan, (2000, Spanish)). Finally, it might affect *both* word order and grammatical function assignment. To investigate these possibilities, I will report two experimental studies which used sentence recall tasks conducted in Japanese. I will start by examining the effect of animacy on two different word orders (SOV and OSV) and NP conjunctions (e.g. *Five people and the boat were gone*) in Japanese (in Experiment 1). Experiment 2 investigates the effect of animacy on both word order and voice (active and passive), where Japanese allows SOV and OSV orders in both active and passive sentences. I conclude that the experimental evidence reported here strongly suggests that there is an effect of animacy on both word order and grammatical function assignment and that these results may

provide evidence of incremental processing in language production (Bock & Levelt, 1994; de Smedt, 1996; Ferreira, 1996; Levelt 1989). These would also suggest a different structure in grammatical encoding, where both grammatical role and serial order assignments in grammatical encoding would be more flexible and parallel (see Kempen & Harbusch, 2004). I then examine why Bock and Warren failed to see a word order effect, and argue that these results could be an artifact of current models of production (Bock & Levelt, 1994; Garrett, 1980; Levelt, 1989; Levelt et al., 1999).

3.1. Introduction

In chapter 2, I overviewed the current models of language production (Bock & Levelt, 1994; Levelt et al., 1999) and the mechanisms involved in it. I noted that many researchers agree that there are three different stages of processing in production: conceptualization, formulation, articulation (e.g., Garrett, 1975; Levelt 1989; Bock & Levelt 1994; Levelt et al., 1999). Formulation is furthermore divided into two levels, grammatical encoding and phonological encoding. In the present chapter I will focus on the grammatical encoding system. I also described in Chapter 2 how grammatical encoding is divided into two different processing levels: the functional level and the positional level. This chapter will examine how conceptual features could influence syntactic processing in language production. I will use the term ‘animacy’ in this context to describe an index of conceptual accessibility (Bock & Warren, 1985), which I already discussed in chapter 2, and will examine how animacy affects grammatical function assignment and word order in Japanese.

In chapter 2, I mentioned that the functional level deals with two processes, the lemma retrieval from the mental lexicon and the grammatical assignment of such lemma items (e.g., subject, object). As a result, the output of the functional level is an unordered list of lemmas that are assigned grammatical functions. At

the next stage, the positional level, word-form retrieval will occur, along with the determination of word order and inflection process.

In this sense, processing tasks at both levels are thought to be different in terms of constructing a sentence. At the functional level, conceptual information is transformed into an unordered sentence in which grammatical function is already assigned. On the other hand, the positional level deals with the linear representation of the sentence. Thus, it has been suggested that processing of both levels could be influenced by different types of information; since functional processing involves the transformation of a conceptual representation into a sentence, such processing might be affected by conceptual information; for instance, salience, thematic roles, and discourse attention are thought to be instances of such conceptual information which would influence syntactic processing (see Osgood 1971; Osgood & Bock 1977; Bock 1977; Bock & Irwin 1980; Flores-d'Arcais 1987; Levelt 1989). In contrast, positional processing deals with constituent assembly (determination of word order), and empirical evidence has suggested that such processing may be influenced by lexical or phonological information (e.g., Bock 1986b; 1987b; Kelly et al., 1986; McDonald et al., 1993). However, some researchers claim that it may not be so clear-cut, and that conceptual representations might influence positional processing as well (Prat-Sala & Branigan, 2000; Branigan & Feleki, 1999). This chapter examines these issues experimentally in Japanese.

Evidence of the influence of conceptual representation at the level of grammatical encoding comes from an experimental study by Bock and Warren (1985). They suggest that the choice of grammatical assignment is affected by what Bock terms conceptual accessibility (Bock & Warren 1985). Bock and Warren claim that conceptual accessibility influences grammatical function in two ways. Firstly, the ease of word retrieval from mental lexicon influences grammatical function assignment, so lemmas which are retrieved faster will be assigned a grammatical function before lemmas which are retrieved less quickly.

Secondly, grammatical functions are assigned by Keenan and Comrie's (1977) NP accessibility hierarchy, such that the subject function is assigned first, direct object second, then indirect object and oblique object. Thus the lemmas which are retrieved faster tend to be assigned as subject, less quickly retrieved lemmas will be assigned as object. Such a process will partly determine the grammatical structure of the sentence (e.g., active or passive).

However, the influence of conceptual representations on both levels is somewhat controversial, since it can be particularly difficult to make a clear dissociation between the effects of grammatical function assignment and word order determination. In particular, various studies which have investigated this issue rely heavily on the English language. English has a relatively rigid word order, and so grammatical function assignment mostly determines the position of words. Thus in the case of English, an NP bearing the grammatical function of subject is usually positioned at the beginning of the sentence. To overcome this difficulty, studies such as Bock and Warren (1985) used NP conjunctions to see the effect of conceptual accessibility. The reason behind this was that the words in the NP conjunctions were within the same grammatical function and the variations on word order could be changed freely. However, NP conjunction is thought to require unusual processing (e.g., Branigan & Feleki, 1999) and so it may not be a good example to use in examining the influence of animacy on word order. Furthermore, many languages have relatively free word order, such as Spanish (Prat-Sala, 1997), Greek (Branigan & Feleki, 1999), German (van Nice & Dietrich, 2003), and Japanese (Tanaka et al., 2005). In this sense, it would be far easier to find a distinction between grammatical function and word order if other languages were examined. As in the example I gave in chapter 2, Japanese can create two different types of sentences which are both semantically the same and have the same grammatical functions but where the simple word orders are different: Subject precedes Object (27a) or Object precedes Subject (27b);

(27)

a. SOV in Japanese

5 人の人がボートを運んだ。

Gonin no hito ga booto o hakon-da.

Five people NOM boat ACC carry-PAST

'Five people carried the boat.'

b. OSV in Japanese

ボートを 5 人の人が運んだ。

Booto o Gonin no hito ga hakon-da.

Boat ACC Five people NOM carry-PAST

'Five people carried the boat.'

The aim of this chapter is to examine whether conceptual accessibility affects word order variation in Japanese. If so, the interesting question would be 'does conceptual accessibility affect both word order AND grammatical function assignment?'

In this chapter, first of all, I will review empirical studies that examine what factors could influence conceptual accessibility focusing on animacy, and how such factors play a role in assigning grammatical functions, both from formal linguistic and psycholinguistic points of view. I will examine in particular detail the claim that animacy may affect grammatical function assignment but not word order variation.

With regard to terminology, in this thesis I will not distinguish human and animals in terms of 'Animacy' as a definition, but I will treat them both as 'animate' entities. In addition, I define NP-*ga*

(nominative case marker in Japanese) as ‘subject’ regardless of the structure (active or passive). NP-*o* (accusative case marking) or NP-*niyotte* (oblique phrase) is called an ‘object’.

3.2. Animacy and Syntactic structure

3.2.0. Introduction

Animacy is an important issue in language. It has been suggested that animacy plays an important role in syntactic structure. Substantial research in theoretical linguistics and psycholinguistics has shown that there is a strong relationship between animacy and syntax. I will examine this below.

3.2.1. Animacy and syntax – theoretical linguistic research

Substantial research in theoretical linguistics has shown that there is a strong relationship between animacy and syntax. For instance, it has been suggested that animacy may influence the choice of case-marking (Aissen, 2003), voice selection (Comrie, 1989), and the role of inflection (Ortmann, 1998) (see Yamamoto 1999 for more general discussion).

First of all, Aissen (2003, also Gair, 1970) discusses that animacy may influence the choice of case-marking. For instance, in language such as Sinhalese¹, while animate objects may be case-marked (as in (28a), inanimate ones may not (28b);

¹ Sinhalese is the official language of Sri Lanka.

(28)

a. *Mama heta wadata miniha-wa evannan.*

I tomorrow work (dat) man-ACC send

I will send the man to work tomorrow.

b. *Mama Heta wadata miniha evannan.*

I tomorrow work (dat) man send

I will send the man to work tomorrow.

Secondly, Comrie (1989) also found the effect of animacy on voice selection. For instance, in the language ‘southern Tiwa’, voice must be used to bring a noun phrase higher in animacy into subject position irrespective of its agreement. In a transitive sentence, if a noun ‘A’ is first or second person, which is higher than or equal to another noun ‘B’ in animacy (according to animacy hierarchy (Yamamoto, 1999), the active expression has to be used (as in (29)-a). However, if a noun ‘A’ is third person and another noun ‘B’ is first or second person, the passive construction has to be used to place a noun ‘B’ in a subject position (as in (29)-b).

(29)

a. *Bey –mu –ban.*

2singular-1singular see Past

‘You saw me.’

b. *Seuanide-ba te –mu –che –ban.*

Man INSTRUMENTAL 1singular see passive past

‘The man saw me’, literally: ‘I was seen by the man.’ (taken from Comrie, 1989)

Thirdly, Ortmann (1998) suggests that animacy plays a role in the assignment of inflection. Ortmann (also Wolfart & Carroll, 1981) suggests that Cree, an Algonquian language, uses different plural suffixes depending on animacy. According to Ortmann, the suffix *-ak* can be characterized as plural and animate ((30)-a), whereas the suffix *-a* only acts as plural when it is added to inanimate entities ((30)-b);

- (30) a. ikwesis-ak sisip-ak
 Girl-PL duck-PL
- b. minis-a astotin-a
 berry-PL cap-PL

A similar distinction can be seen in Breton, one of the languages spoken in France, where the suffix *-ed* is added to animate nouns ((31)-a), but not to inanimate ones ((31)-b) (Press, 1986).

- (31) a. paotr paotr-ed
 boy boys-PL
- b. bag bag-ou
 Boat boat-PL

In sum, studies on theoretical linguistics have shown strong evidence that there is a strong relationship between animacy and syntax.

3.2.2. Animacy and syntax – psycholinguistic research

The effect of animacy can also be found in experimental research. Several researchers have found that a speaker's preference to produce passive forms increases when the patient of the action in a sentence is human or animal (Bock, Loebell & Morey, 1992; F. Ferreira, 1994; McDonald et al., 1993). Although such studies used the English language, many studies using other languages also found similar effects, such as German (van Nice & Dietrich, 2003), Spanish (Prat-Sala, 1997), and Japanese (Tanaka et al., 2005). Recent research has also demonstrated that variations in animacy influence the choice of word order; for instance in Greek (Branigan & Feleki, 1999), Japanese (Tanaka et al., 2005). Similar influences have been found in the corpus-based studies, such as animacy plays a role to influence the choice of double object (DO) versus prepositional object (PO) structures in German (Kempen & Harbusch, 2004), and the choice of the *s-* versus *of*-genitive in English (Rosenbach, 2005). In sum, such findings seem to suggest that there is a general preference for structures to place animate entities in syntactically prominent positions.

In theoretical linguistics, it has been claimed that the effect of animacy may be 'epiphenomenal to other factors' (Rosenbach, 2008). For instance, Rosenbach (2008) suggests that in English language, animate, definite, and short elements have a strong tendency for being placed early in a sentence (this is called a firstness effect). However, it is not clear if it is only animacy which causes such the firstness effect. In the case of example '*John's book*', it is hard to tell why the *s*-genitive is preferred to the *of*-genitive (*book of John*) because this firstness effect could be due to other factors, such as the topicality of reference (e.g., Deane, 1987) or weight (shorter elements tend to appear earlier than longer elements in sentences; Hawkins, 1994).

Although such claims could explain some of the observed phenomena, corpus and experimental-based

research has also shown the independent effects of animacy on grammatical variation. Based on a German corpus study, Kempen and Harbusch (2004) examined the linear order frequencies of double-objects and indirect-objects when the subject was either animate or inanimate and suggested that animate entities tended to precede inanimate entities independently of definiteness in a corpus of German adverbial and complement clauses (I will come back to this study later). Rosenbach (2005) ran the questionnaire-based study that participants were presented with short messages taken from crime fiction novels. Her participants were asked to make a choice about using either the *s*-genitives or the *of*-genitives (e.g., ... *she was holding [the dark man's hand/ the hand of the dark man]*) in the given contexts. The results of her study showed that participants preferred English possessives in which the animate entity preceded the inanimate entity (*boy's eyes*) rather than vice versa (*eyes of the boy*), even when the possessor and possessee were controlled for syntactic complexity and given/new information structure.

3.3. Incremental processing and Conceptual accessibility

3.3.1. Incremental model of production

In order to understand the effect of animacy on syntactic processing in language production, we must first understand current models of language production. In chapter 2 I discussed the current models of language production, which distinguish between three different levels of processing – conceptualization, formulation, articulation (Bock & Levelt, 1994; Levelt, 1989; Garrett, 1980). Formulation is furthermore divided into two different stages, grammatical encoding and phonological encoding. It is generally accepted that speakers begin to express a meaning at the stage of conceptualization, and then they try to map this pre-linguistic message onto the appropriate lexical items and their associated lemmas - the syntactic component of lexical entries (Levelt, Meyer & Roelofs, 1999; Kempen & Huijbers, 1983) then

generated from the syntactic information contained within the lemmas (Kempen & Hoenkamp, 1987) during grammatical encoding. These representations are finally converted into phonological representations at the level of phonological encoding.

First, I will focus on grammatical encoding. I also discussed in the previous chapter that there is a split between functional and positional processing. Following Bock and Levelt (1994), during functional processing, a speaker's task is to choose the correct lexical items and assign them the appropriate syntactic functions. However, such information is not ordered yet, thus the retrieved lexical items have to be placed in the right order (a process referred to as constituent assembly). Then morphological information (e.g., tense, number) or case-making subsequently is assigned.

As I discussed in chapter 2, it has been suggested that the production system is designed in a way that allows it to be quick and fluent, otherwise the conversation would consist of silences or hesitation. From these facts, many researchers suggested that language production is an incremental process (e.g., de Smedt, 1994; Ferreira, 1996; Kempen & Hoenkamp, 1987; Levelt, 1989). Under this assumption, speakers can produce an utterance as soon as the minimal information is available. Thus speakers do not have to wait until they receive all the necessary information before beginning an utterance. I also discussed in chapter 2 that there is considerable evidence for the incremental model of language production from experimental studies (e.g., Ferreira, 1996). In the next section, I will discuss more evidence of incremental processing in production from experimental studies.

3.3.2. Conceptual accessibility

More evidence for this incrementality comes from a hypothesis called conceptual accessibility (Bock

& Warren, 1985; see also Bock (1987)). As seen in chapter 2 Bock and Warren defined conceptual accessibility as 'the ease with which the mental representation of some potential referent can be activated in or retrieved from memory' (Bock & Warren, 1985:50). This suggests that some entities are conceptually more accessible than other entities because they take part in more conceptual relations, and hence these can be retrieved faster, therefore these tend to appear earlier in sentences. It is also important to note that various studies have found similar effects of conceptual accessibility, by using aspects such as concreteness (H.H. Clark & Begun, 1971; Bock & Warren, 1985), prototypicality (Kelly et al., 1986), imageability (James, Thompson & Baldwin, 1873), animacy (H.H. Clark, 1965; Harris, 1978; McDonald et al., 1993), givenness (Carroll, 1958; Halliday, 1970), definiteness (Grieve & Wales, 1973), perspective (MacWhinney, 1977), conceptual focus (or speaker's interests, Tannenbaum & Williams, 1968), empathy (Ertel, 1977; Kuno & Kaburaki, 1977), and salience (Osgood & Bock, 1977). If this is the case, it would be strong evidence for an incremental account of language production, because one particular noun is retrieved faster than the other one, and as a result conceptually accessible nouns appear earlier in the utterance.

Thus, as a result of incrementality, it is assumed that factors that relate to conceptual accessibility such as animacy strongly influence the process of language production. The question to be addressed here is 'how does conceptual accessibility affect syntactic processing in language production?' Empirical studies suggested two possibilities. Firstly, they claimed that conceptually accessible items might be associated with higher grammatical functions (Bock & Warren, 1985; McDonald et al., 1993), alternatively, conceptual accessibility might be associated with serial word order (Bock, 1982; Branigan & Feleki 1999; de Smedt, 1994, 1996; Kempen & Harbusch, 2004; Levelt, 1989).

Bock and Warren (1985) hypothesised an accessibility effect with two components. Firstly, lemmas which are retrieved faster are assigned grammatical functions before lemmas which are retrieved less fast.

Secondly, grammatical functions are assigned following Keenan and Comrie (1977)'s NP accessibility hierarchy, such that the subject function is assigned first, followed by direct object, indirect object, and oblique object. Therefore, the most highly activated words will be assigned the subject function; the next most highly activated words will be assigned the direct-object function, and so on. As a result, this suggests there may be a link between animacy and subjecthood. However, Bock and Warren clearly suggested that conceptual accessibility does not influence word order directly.

Alternatively, conceptual accessibility might be associated with serial word order (Bock, 1982; Branigan & Feleki 1999; de Smedt, 1994, 1996; Kempen & Harbusch, 2004; Levelt, 1989). It has been claimed that these conceptually accessible items might be associated with early word order positions, thus easily retrieved items would tend to be in the first position of the sentence. In this case, it is possible that there would be a direct link between animacy and first position in the sentence.

In sum, the empirical studies suggest two possibilities; first, Bock and Warren (1985) and McDonald et al. (1993) claimed that conceptually accessible items might be associated with higher grammatical functions; alternatively, conceptual accessibility might be associated with serial word order (Bock, 1982; Branigan & Feleki 1999; de Smedt, 1994, 1996; Kempen & Harbusch, 2004; Levelt, 1989). Below I review some of these studies.

3.4. Conceptual accessibility and grammatical function assignment

Three experimental works using two different methodologies in English showed the effect of conceptual accessibility. The first methodology was the sentence recall task used by Bock and Warren (1985) and McDonald, Bock and Kelly. (1993), and the second was the picture description task used by

Bock, Loebell and Morey. (1992).

3.4.1. Sentence recall tasks

Firstly, Bock and Warren (1985) adopted imageability (cf. Paivio (1971)) as a measure of conceptual accessibility and examined whether conceptual accessibility affects grammatical function assignment or word order. They used a sentence recall task, in which they had people recall sentences in a form which allowed conceptually accessible nouns, such as more concrete or imageable entities, to appear in higher-level grammatical roles.

Although recalling may be a risky way to investigate the language production system, it is suggested that a sentence recall task is a good method in language production (Bock, 1996). First of all, in the sentence memory literature, several researchers have used tests of recognition memory for sentence and showed that, although short-term memory is essentially verbatim immediately after hearing or reading a sentence, the exact details of the syntax and vocabulary can be lost if even one sentence is presented before recalling a sentence (Sachs, 1967, 1974, Anderson & Paulson, 1997). Secondly, in the study of language production, Bock (1996) suggested that recalling is rarely reproductive and so often reconstructive, and there are two important points about the recall method – (1) it is difficult for speakers to recall the exact words/sentences that they heard, even after brief intervals (Potter & Lombardi (1990), and (2) speakers have very little difficulty to remember the gist of what they hear (Jarvella, 1971). In this way, I can assume that speakers can generate the abstract message and use the message to generate the linguistic content. Such an elicited recall of these messages is thought to be similar to the natural process of language production (Bock, 1982, 1996; Levelt & Kempen, 1975; Lombardi & Potter, 1992). In fact, a sentence recall task has been used in many experimental studies and showed that recalling is a good method in language production (e.g., Bock

& Irwin, 1980; Bock & Warren, 1985; McDonald et al., 1993; Potter & Lombardi, 1990, 1998; Lombardi & Potter, 1992). I will review these studies below.

Potter and Lombardi (1990, 1998), Lombardi and Potter (1992)

Potter and Lombardi (1990) claimed that while humans could not remember more than 6 or 7 *unrelated* words at the same time (e.g., Miller, 1956), it was possible for people to recall 14 to 20 *related* words immediately. This suggests that not all the words were being stored in the short term memory. In Potter and Lombardi's (1990) experiments, their participants read sentences, and after a distractor task, they were asked to recall the sentences they had read. As a distractor task, participants were asked to read a short list of nouns which included a lure word such as '*castle*' (rightly synonymous with '*palace*'). Potter and Lombardi found that when the original sentence (e.g., *The knight rode around the palace searching for a place to enter*) was presented and after participants read the lure word, they were more likely to recall the original sentence with the lure word (e.g., *The knight rode around the castle searching for a place to enter*) than the original word. This suggested that speakers confused their recall of the sentence with recently activated words. When they recalled the sentence, they used recently activated syntactic structures. This study therefore suggests that the original surface structure may not be represented in the short-term memory.

Lombardi and Potter (1992) further investigated this issue using the same task as Potter and Lombardi (1990). They manipulated the experimental sentences with alternator or non-alternator verbs (see Ferreira 1996). For instance, when their participants read DO sentences with the verb '*gave*', participants could describe pictures using either DO or PO sentences. But when the lure word was a non-alternative verb such as '*donate*', participants could only create sentences with a PO form. Lombardi and Potter found that when

participants produced a non-alternator verb which did not match the original structure, they were likely to change the syntactic structure of the sentence (since the alternative structure was grammatical). Such results led Lombardi and Potter to conclude that the surface structure of the sentence was not represented in memory; rather, it was re-generated from grammatical encoding mechanisms, and in the end the verbs determined the word order. The problem with their account was that it did not explain the fact that participants produced their recalled sentences in a way similar to what they had heard before (in the same structure such as passive-passive). When alternator verbs were presented they primed production of either the PO or DO structure. Thus it was likely that the structure which had been recently activated tended to be produced more than the other structure. Lombardi and Potter suggested that recently activated syntactic structures were likely to be re-used.

Potter and Lombardi (1998) also investigated such issues with the same sentence recall task. They found that when the structure of prime sentences was mismatched to a target with alternative structures, their participants recalled the target sentence with the prime structure. In subsequent experiments, they presented sentences in which the target clause was a dative and the other was the prime (e.g., *The waitress handed a customer two glasses and then sent the manager her resignation.*). Potter and Lombardi manipulated which of the clauses was the prime and which was the target. In both cases where the prime sentence had been read or recalled, or only read but not recalled, their participants showed a priming effect. They also argued that this account is consistent with the relatively rapid loss of verbatim memory for a sentence, as the processes involved are subject to rapid decay (see Chapter 4 for more discussion of Potter & Lombardi's study).

In sum, experimental studies by Potter and Lombardi, and Lombardi and Potter showed that it is not possible for speakers to store all words in short term memory, but speakers have to regenerate the message

from the beginning of the production system. These claims suggested that sentence recall would be a good method to simulate the natural process of production (Bock, 1982).

Bock and Warren (1985), McDonald, Bock and Kelly (1993)

Using a sentence recall task, Bock and Warren (1985) examined the effect of conceptual accessibility in language production. Bock and Warren’s target sentences involved two entities, corresponding to one more imageable and one less imageable noun. They presented these nouns in (32) transitive sentences (actives vs. passives), (33) dative sentences (prepositional objects vs. double objects), and (34) phrasal conjunct sentences. Below are the examples:

(32)

- a. *The doctor administered the shock.*
- b. *The shock was administered by the doctor.*

(33)

- a. *The old hermit left the property to the university.*
- b. *The old hermit left the university the property.*

(34)

- a. *The lost hiker fought time and winter.*
- b. *The lost hiker fought winter and time.*

In examples (32), (33) and (34), the imageability of two noun phrases differed. In transitive sentences

such as (1), the underlying subject (*doctor*) and direct object (*shock*) differed in imageability, while in datives as in (33), the underlying direct (*property*) and indirect objects (*university*) differed. Bock and Warren suggest that the differences of word orders in the active/passive and prepositional/double object sentences are also associated with differences in grammatical function. Thus, assuming an incremental process of production, if more imageable nouns tend to precede less imageable ones, it is possible to conclude that conceptual accessibility such as imageability can influence the choice of grammatical function assignment.

Meanwhile, in sentences with phrasal conjuncts like (34), two noun phrases (*time and winter*) within conjuncts differed. Since *time and winter* may exchange positions without changing the syntactic structure, if the difference of imageability influences the choice of NP conjunctions, the recall order of phrasal conjunct sentences would be influenced by conceptual accessibility, placing more imageable nouns earlier than less imageable nouns.

Bock and Warren examined the effect of 'inversions' during recall tasks, where participants recalled the meaning of a sentence correctly, but produced an alternative syntactic structure, such as an active sentence in a passive form. For instance, if more imageable nouns (e.g., *doctor*, *time*) are retrieved faster than less imageable nouns (e.g., *shock*, *winter*), then the sentence such as '*The shock administered the doctor*' tended to be recalled as '*The doctor was administered by the shock*', or '*The shock was administered by the doctor*' tended to be recalled as '*The doctor administered the shock*'. In conjunct cases, the sentences such as '*The lost hiker fought winter and time*' tended to be recalled as '*The lost hiker fought time and winter*'. The results of Bock and Warren's study showed that participants tended to invert active/passive sentences and prepositional/double object sentences when more imageable nouns were placed in a higher grammatical role. However their participants did not produce word order inversion of

phrasal conjuncts when the more imageable nouns were placed first. Taken together, Bock and Warren concluded that conceptual accessibility influences grammatical function assignment, but not serial word order directly.²

In another, McDonald, Bock and Kelly (1993) conducted sentence recall tasks using animacy as an example of conceptual accessibility. They hypothesised that animate entities tend to precede inanimate entities in utterances, following Cooper and Ross (1975)'s argument of animate leaders. Cooper and Ross observed the preference for animates to precede inanimates in utterances. They described this as the 'Me First' principle, which according to Cooper and Ross is the tendency for speakers to place first those things that are mostly closely linked to their self-images. In fact, Byrne and Davidson (1985) experimentally tested this hypothesis and found that children tended to remember *horse – cart* name orders (in other words animate-inanimate orders) better than *cart – horse* name orders (inanimate – animate orders).

Thus, McDonald et al. (1993) examined the effect of animacy on (35) active/passive sentences and (36) phrasal conjuncts where animacy was manipulated:

(35)

- a. *A farmer purchased a refrigerator.*
- b. *A refrigerator was purchased by a farmer.*

(36)

- a. *The dog and the telephone were both making noise.*
- b. *The telephone and the dog were both making noise.*

² Although they provided the percentages of inversions in each condition, Bock and Warren did not provide any raw numbers of participants' responses in their paper. Therefore it is not clear how many errors their participants produced in each condition.

Following a similar recall task to Bock and Warren (1985) and McDonald et al. (1993) found a tendency for animate nouns to precede inanimate nouns in the transitive sentences but not in the conjuncts. When both animate nouns and inanimate nouns appeared in the same subject position of conjunct phrases, the effect of animacy disappeared. This finding was consistent with the hypothesis by Bock and Warren (1985) where conceptual accessibility influences the choice of grammatical function assignment. In their last three experiments, only phrasal conjuncts were presented (i.e., two words were not bound to any event role, such as '*farmer and refrigerator*'; '*dog and telephone*'). In these conditions, participants showed a strong tendency to produce animate entities before inanimate ones. From these results, McDonald et al. (1993) suggested the effect of animacy leadership arose because of the fact that both animate and inanimate words were not bound to any event role in these conditions. McDonald et al. (1993) furthermore proposed that when participants heard the phrasal conjuncts they attributed some type of event role to each entity (for example, one was assigned the event role of agent and the other, the event role of patient). They suggested that such tendency was related to the notion called 'predicability' (Keil, 1979). Predictability can differ substantially for different concepts. Since a human being can enter into many different relations such as eating, sleeping, talking, arguing and ironing, a human being is thought to be more highly predictable than other entities such as animals, which would be a fewer relations (animals like *dogs* will not be ironing). Highly predictable entities tend to be both concrete and prototypical, and animate entities are also thought to be more predictable than inanimate ones. Thus Bock and Warren (1985) suggests that animate entities have high conceptual accessibility and are easy to retrieve. These results were consistent with the hypothesis by Bock and Warren (1985) and gave further support of the hypothesis that conceptual accessibility influences grammatical function assignment and not word order.

3.4.2. Picture description task - Bock, Loebell and Morey (1992)

Using a different methodology, Bock, Loebell and Morey (1992) conducted a picture description task to investigate the effect of animacy on grammatical encoding. Many researchers have found that speakers show a tendency to re-use the previous syntactic structure that they have just used (*syntactic priming*, e.g., Bock, 1986; Pickering & Branigan, 1998. More details will be discussed in chapter 4). For instance, after speakers read a passive sentence such as '*The church is being struck by lightning*', they tend to repeat passive structure, subsequently describing a picture as '*The boy is being woken by the alarm clock*', instead of using the active structure '*The alarm clock woke the boy*'. Bock et al. (1992) conducted a picture description task, presenting participants with a variety of sentence structures (active/passive sentences) and animacy (animate subject/inanimate subject). They found an overall tendency to repeat the same syntactic structure (active after active, passive after passive). Crucially, their participants were more likely to describe the pictures with inanimate subjects rather than animate subjects after they read the sentences with inanimate subjects. These two effects were independent, thus the tendency to produce inanimate-animate occurred regardless of syntactic structures (active or passive). This suggests that there was a tendency to repeat the assignment of a particular animacy to a particular grammatical function. Thus once again, Bock et al.'s (1992) result was consistent with Bock and Warren's hypothesis that grammatical function assignment is affected by the animacy variation.

To sum up, the results of Bock et al.'s (1992), Bock and Warren (1985) and McDonald et al.'s (1993) experiments suggested that the choice of active/passive in English was affected by conceptual accessibility. However, the linear order of NP conjunction did not change even if the accessible and less-accessible nouns were manipulated. Thus these researchers concluded that conceptual accessibility influences the choice of grammatical function assignment, but not directly the linear word order.

However, there are several reasons why we might doubt the conclusions of Bock et al. (1992), Bock and Warren (1985) and McDonald et al. (1993). First of all, several researchers have proposed alternative models of production which avoid the restricted incrementality entailed by the grammatical function model. The details of these models differ, however it is important to note that all these models allow conceptually more accessible entities to claim early serial positions, irrespective of grammatical function (de Smedt, 1990; Kempen & Hoenkamp, 1987; Levelt 1989). If so, it would be possible that the rigid word order in English prevents us from examining the true effect of conceptual accessibility on word order. It may be that the processing of NP conjunctions may not be the same as the processing of main clause linear word order that we can see in other languages (e.g., Branigan & Feleki, 1999 (Greek); Prat-Sala & Branigan 2000 (Spanish) or Tanaka et al., 2005 (Japanese)). In addition, several experimental works (Prat-Sala & Branigan 2000; Branigan & Feleki, 1999) and corpus studies (Kempen & Harbusch, 2004) have shown a direct link between conceptual accessibility and linear word order. Thus it is worth investigating other languages to examine the true effect of conceptual accessibility on word order. In the next section, I discuss the problems of Bock and Warren's (1985) and McDonald et al.'s (1993) argument based on NP conjunction, examine the effect of conceptual accessibility on other languages (e.g., Spanish, Greek), and see how conceptual accessibility affects word order variation.

3.5. The effect of conceptual accessibility on serial word order

One particular concern is the rigid word order of English. Bock and her colleagues concluded, from the results of English NP conjunction, that conceptual accessibility does not affect serial word-order. It is unclear how their model accounts for the systematic variations in word order which can be found in other languages, in which lower grammatical functions precede higher grammatical functions. Thus testing the effect of conceptual accessibility on other languages which allow flexible word order is important.

Empirical studies using Greek (Branigan & Feleki (1999) or Spanish and Catalan (Prat-Sala & Branigan, 2000), German (Kempen & Harbusch 2004), and Odawa (Christianson & Ferreira, 2005) tested the possibility of a link between conceptual accessibility and serial word order. I review these empirical studies below.

Branigan and Feleki (1999)

The first study was by Branigan and Feleki (1999). They conducted a sentence recall task of transitive sentences in Greek. One important difference between English and Greek is that word order variations exist for normal declarative sentences. For example, Greek allows the subject of a sentence to precede or follow the verb and also the direct object. This is particularly important because in Greek we can see any variation of word order caused by animacy, but it is independent from grammatical function assignment.

In Branigan and Feleki's experiment, they focused on the subject-verb-object (SVO) and object-verb-subject (OVS) orders, in which they systematically manipulated two nouns' animacy. As in Bock and colleagues' experiments, the sentence recall task was performed to test conceptual accessibility effects on word order. As the examples below show, (37a) and (37b), or (37c) and (37d) are semantically equivalent sentences, but the object phrase *Law-acc* can precede the subject phrase *Citizen-nom* as well as follow it, resulting in the alternative word order sentence of (37b) or (37d) as well as (37a) or (37b);

(37)

(a) Sta dimokratika politevmata, o politis sevete to sindagma.

in democratic regimes the citizen-NOM respects the law-ACC

'In democratic regimes, the citizen respects the law'

(b) Sta dimokratika politevmata, to sindagma sevete o politis.

in democratic regimes the law-ACC respects the citizen-NOM

'In democratic regimes, the citizen respects the law'

(c) Sta dimokratika politevmata, to sindagma sevete ton politis.

in democratic regimes the law-NOM respects the citizen-ACC

'In democratic regimes, the law respects the citizen'

(d) Sta dimokratika politevmata, ton politis sevete to sindagma.

in democratic regimes the citizen-ACC respects the law-NOM

'In democratic regimes, the law respects the citizen'

Branigan and Feleki's results suggested that participants tended to recall sentences in a form that allowed the conceptually more accessible entity to precede the less accessible entity, irrespective of grammatical function. Thus, their participants tended to recall SVO sentences as OVS more when the subject was inanimate and the object was animate (10%), than when the subject was animate and the object was inanimate (2%). Equally, their participants were likely to recall OVS orders as SVO more when the animate noun was in the subject position (47%) than when the inanimate noun was in the subject position (36%). In both cases, inversions would result in the animate entities appearing first. Therefore, this suggested that animate entities tended to appear first even when their grammatical role was as an object.

Prat-Sala and Branigan (2000)

Secondly, Prat-Sala and Branigan (2000) divided conceptual accessibility into two components:

Inherent accessibility (e.g., animacy) and Derived accessibility (e.g., givenness). According to Prat-Sala and Branigan (2000), both contribute to overall accessibility: Animate or salient entities appear earlier than inanimate or salient entities, and inanimate or salient entities precede animate or non-salient entities. They examined Spanish and English, which allow active/passive formations. Thus the agent and the patient in a transitive sentence can be placed in two ways – the agent NP as a subject of the active sentence, or the patient NP as an oblique object of the passive sentence. In addition to this, Spanish allows dislocated active sentences. Compared to a canonical active sentence, this dislocated active sentence simply allows a different word order, but maintains exactly the same grammatical functions. Thus as in examples below, in dislocated sentences, the subject follows the verb (the object precedes the verb).

(38) La nina rego las flores. (Spanish)

the girl-Nom watered the flowers-Acc.

'The girl watered the flowers.'

(39) Les flores las rego la nina. (Spanish)

The flowers-Acc them watered the girl-Nom

'The girl watered the flowers.'

In their experiment, pictures were shown to the participants and these were paired with two versions of a tape-recorded short story. The short stories contained both of the entities, but were constructed to make one of the entities more salient. Each story ended with the open question '*WHAT HAPPENED?*'. For example, if a picture depicted the action of a swing hitting a scooter, the story could make salient either *the swing* (the agent), as in (40), or *the scooter* (the patient), as in (41).

(40) *There was this old rusty swing standing in a playground near a scooter, swaying and creaking in the wind. What happened?* (Agent-salient)

(41) *There was this old red scooter standing in a playground near a swing, with rusty wheels and scratched paint. What happened?* (Patient-salient)

Prat-Sala and Branigan observed that speakers were more likely to produce more salient entities in a higher syntactic position than less salient ones. In the English trials, speakers produced more passives than actives when the patient was salient (27.4%) than when the agent was salient (9.8%). In Spanish, more dislocated sentences were produced when the patient of the dislocated sentence was salient (62.3%) than it was not salient (22.8%). Prat-Sala and Branigan concluded that both inherent accessibility and derived accessibility influence the production in English and Spanish. In other words, these factors affect not only grammatical function assignment, but also serial word order.

Kempen and Harbusch (2004)

Kempen and Harbusch (2004) conducted a corpus analysis of natural language in German. German grammar does not have strict word order constraints on the linear order of subject, indirect object and direct object in finite complement or adverbial clauses. They examined how German speakers control linear word orders. They examined data from the NEGRA-2 corpus (Skut et al., 1997), containing almost 20,000 newspaper sentences annotated in full syntactic detail. They particularly identified and examined the linear order frequencies of double-objects and indirect-objects when the subject was either animate or inanimate. The corpus data showed reliable differences in both double/indirect objects. Although they did not find a difference in linear order frequency of double objects and indirect objects when the subject was animate

(direct object first; 52 ordered pairs, direct object second; 56 pairs, indirect object first; 17 pairs, indirect object second; 20 pairs), there was an increased frequency of direct objects first or indirect objects first when there was an inanimate subject (direct object first; 11 pairs, direct object second; 64 pairs, indirect object first; 3 pairs, indirect object second; 39 pairs). Kempen and Harbusch claimed that their results showed a 'direct' effect of animacy on linearization processes in German.

Christianson and Ferreira (2005)

Christianson and Ferreira (2005) conducted a picture description task in the Odawa language. According to Christianson and Ferreira, Odawa language is a free linear order language and allows any NPs to be freely placed within the clause. This free order in Odawa is slightly different from the one in Japanese (which I will discuss later), because Odawa also allows Verbs to be ordered freely. Thus in transitive sentences, all orders are possible; VSO, VOS, SVO, OVS, SOV, OSV. Unlike Japanese, which uses case-marking to mark syntactic functions, Odawa has several verb forms which determine this syntactic function. The transitive direct form (direct) is for the subject (and thematic agent), a less frequent inverse verb for the object as topic, and passive form for the patient as topic and subject. They examined if these types of question would influence the choice of speakers' syntactic form in their picture descriptions, and how the variations in animacy (human or animal in their case) would influence the choice of syntax in Odawa production. Their participants looked at pictures with transitive actions, and the experimenter asked the following three types of questions. After the questions, participants were asked to describe the pictures orally.

(42).

a. Aaniish e-zhiwebag zhinda? General Question (GQ)

what PRES.Conj-happening here

What is happening here? (General Question)

b. Aaniish e-nanikiid gwiizens? Agent Question (AQ)

what PRES.Conj-doing boy

What is the boy doing? (Agent-topicalizing Question)

c. Aaniish e-zhiwebizid kwezen? Patient Question (PQ)

what PRES.Conj-happening.to girl

What is happening to the girl? (Patient-topicalizing Question)

In Odawa, although the three types of questions contained different topicalizing properties, the verb forms and word order were identical, which was particularly useful for testing the effect of animacy on word order.

Overall, participants tended to describe all types of pictures with direct verbs (SVO). However there was a significant increase in passive and inverse forms after the patient question. Christianson and Ferreira argued that this was an example of conceptual accessibility in Odawa. However, their participants produced fewer passive forms after the same Patient question type when the pictures were animal-agent/human-patient than human-agent/animal-patient. Thus although Odawa allows relatively free linear word order, Odawa speakers tended to describe pictures with passive verbs but not inverse verbs after the patient-question. They concluded that a radical incremental model of production (e.g., Kempen &

Hoenkamp (1987) or de Smedt (1990, 1994, 1996), predicting that the most accessible items are always retrieved faster, may not be sufficient to explain Christianson and Ferreira's results. Instead, Christianson and Ferreira suggested that a relatively weak incremental model of language production should be able to explain this phenomenon. This was similarly proposed by Ferreira and Dell (2000), who ran a series of experiments in which participants were faced with a choice between producing or omitting the optional complementizer *that* as in '*The coach knew (that) you missed practice*'. They found that mention of the complementizer 'that' was 'sensitive to the availability of the material that is spoken' (p. 326). However, since complementizer '*that*' (function words) and pronouns or full NPs '*that*' (content words) may not be produced in the same way (e.g., Garrett, 1988), Ferreira and Dell claimed that the choice of including or omitting complementizer 'that' is not simply the choice of including or omitting a lexical item, rather it is the choice of producing one syntactic structure with or without complementizer 'that'. Thus, Ferreira and Dell proposed a relatively weak incremental model of language production, in which lexical items may influence wording decisions through syntactic mechanisms. Although part of their results did not support the radical incremental account of production (I will discuss this in the conclusion), their results were partially supportive of the effect of conceptual accessibility.

In sum, while Bock and her colleagues found that the effect of conceptual accessibility was limited to grammatical role assignment, these studies clearly suggested that animacy affects word order variation in sentence production. In the next section, I examine the problems of testing the conceptual accessibility effect using NP conjunctions.

3.6. NP conjunction and third model of grammatical encoding

Although the claim that conceptual accessibility only influences the assignment of grammatical

functions was supported by several experimental studies such as Bock and Warren (1985), McDonald et al. (1993) and Bock et al. (1992), several studies from corpus-based studies (Kempen & Harbusch, 2004) and experiments in other languages (Branigan & Feleki, 1999; Prat-Sala & Branigan, 2000) have suggested the possibility that conceptual accessibility may affect not only grammatical function assignment but also variations in word order. It is also possible that Bock et al.'s (1992) syntactic priming effect might be a result of word order preferences, that is, it could be a simple repetition of the order of animacy that appeared (pre-verbal vs. post-verbal animate NP).

However, it is clear that the problem of Bock and Warren's and McDonald et al.'s account was that they relied on NP conjunctions to examine the serial word order effect. In theoretical linguistics, it has been assumed that NP conjunctions involve a rather complex process (Chomsky, 1957), and some linguists have proposed that they are multiple-headed (Gazdar et al., 1985). NP conjunctions may therefore be processed in an unusual way.

In fact, there have been some conflicts about the experimental results regarding the effect of conceptual accessibility on NP conjunctions. Even though Bock and Warren (1985, concreteness) and McDonald et al. (1993, animacy) did not find any accessibility effect on NP conjunctions, there have been several studies which found such effects. Cooper and Ross (1975) showed that there is a preference order of animacy on 'frozen' conjunct orders. In English grammar some of the conjunct orders appear to occur in a specific way (e.g., *husband and wife*). Such orders are called frozen orders and there may be some semantic consistency behind this. In particular, Cooper and Ross found a tendency for animate preceding inanimate in such a frozen order (e.g., *horse and buggy*). Byrne and Davidson (1985) experimentally tested and found that children tended to remember *horse – cart* name orders (in other words animate-inanimate orders) better than *cart – horse* name orders (inanimate – animate orders). Apart from animacy, Kelly, Bock and Keil

(1986) investigated the effect of conceptual accessibility on NP conjunctions and they found that their participants recalled sentences with more prototypical words (e.g., *red, beer*) preceding non-prototypical words (e.g., *gold, rye*) in conjuncts.

On the other hand, Branigan and Feleki (1999) suggested that in the processing of normal declarative sentences (e.g., SVO), the retrieval of a single noun lemma controls the syntactic elaboration of the noun phrase. Hence as soon as the processor retrieves just the noun lemma, it can decide upon the syntactic processing of this noun. In contrast, the processing of NP conjunctions appears to be different. In this case the processor has to deal with two noun lemmas separately, one for each conjunct. In addition, the syntactic elaboration of the conjunctive phrase is determined by the syntactic features of both conjuncts. For example, agreement is determined with reference to both conjuncts. Thus it may not be plausible to assume that the processes for declaratives and conjuncts work in the same way.

In this sense, it is possible to suggest that Bock and her colleagues' did not test the true effect of conceptual accessibility. However, it is also true that Branigan and Feleki (1999) also did not test the effect of conceptual accessibility on grammatical function assignment in Greek (however, they did suggest that Greek speakers produced more passive sentences when the patients were animate nouns). Therefore, it is still questionable whether both approaches about how conceptual accessibility influences only grammatical function assignment (Bock & her colleagues) or word order (Branigan & Feleki, 1999; Prat-Sala & Branigan, 2000) are right to some extent. Thus, as Branigan and Feleki (1999) suggested, it is possible to suggest that conceptual accessibility (animacy) may affect both grammatical functions and word order. It is clearly suggested that both approaches did not test the effect of conceptual accessibility both on grammatical function assignment and word order. If there is a language which allows to test the effect of conceptual accessibility on the grammatical functions and word order separately, it is possible to investigate

the true effect of conceptual accessibility. This issue will be returned to in the general discussion.

To sum up, although Bock and Warren (1985) and MacDonald et al. (1993) claimed that conceptual accessibility only affects the choice of grammatical function assignment, some evidence from other languages such as Greek, Spanish, German, and Odawa suggested that conceptual accessibility also affects word order. However, there is an argument about whether conceptual accessibility could affect both at the same time (Branigan & Feleki, 1999). Bock and Warren (1985) investigated this issue by using active/passives, Direct/Prepositional Objects, and NP conjunctions. However, as I discussed earlier, it may be possible that NP conjunctions may not represent the effect of conceptual accessibility on word order due to the linguistic complexity of NP conjunction. The concern of this paper is to investigate these hypotheses in Japanese. Can one of these accounts explain animacy effects in Japanese sentence production? Or is there an alternative account to explain conceptual accessibility effects in language production? Such that the effect of conceptual accessibility may be both on grammatical function assignment and word order. I used Japanese, a relatively free word order language, to examine the true effect of conceptual accessibility.

3.7. Japanese

In this section, I discuss the literature on Japanese syntax and examine why Japanese is suitable for this study.

Japanese is a language which allows a wide range of structures that separate serial word order from grammatical function. As Branigan and Feleki (1999) pointed out, Bock and her colleagues (Bock & Warren, 1985; McDonald et al., 1993) conducted an experiment on NP conjunctions to test word order effects. This was because NP conjunctions are almost the only structure in English where grammatical

function and serial order are separable. However, since I argued that the linguistic properties of conjunctions are debated and are not suitable for testing the conceptual accessibility effect, it is necessary to find alternative examples, where word order can be found in simple declarative sentences. This is possible in Japanese.

The basic word order in Japanese is Subject-Object-Verb. The major constraint on word order in Japanese is that the verb has to be placed in the sentence final position (see Kuno, 1973). In order to decide syntactic function, case-marking is used - *wa* (Topicalization), *ga* (Nominative), *ni* (Dative), *o* (accusative) etc. Therefore, as long as there is case-marking, Japanese speakers know which syntactic function the noun has. Thus both the subject and the object of a sentence can appear at the beginning of the sentence without changing any meanings. Note that as in animate subjects of transitive clauses, inanimate subjects of transitive clauses are usually thought to be marked in Japanese.

Here I focus on subject-object-verb (SOV) and object-subject-verb (OSV) orders. This is particularly useful when we are aiming to see the effect of word order in production. For instance, while a scrambled sentence (44) is possible in Japanese, English does not allow any comparable word order variation (43) ³;

(43) ... S(ani) O(inani)V

5 人の人がボートを運んだ。

Gonin no hito-ga booto-o hakon-da.

Five people-nom boat-acc carried-past

‘Five people carried a boat.’

³ Abbreviations are as follows; Ani – Animate, Inani – Inanimate, Nom – Nominative, Acc - Accusative

(44) ... O(inani) S(ani)V

ボートを5人の人が運んだ。

booto-o Gonin no hito-ga hakon-da.

boat-acc Five people-nom carried-past

'A boat, Five people carried.'

Sentence (44) is a scrambled version of the simple declarative sentence (43). Both have the same meaning and the same assignment of grammatical functions; the only difference is the positions of the two nouns. *boat-o* moves to the front of the sentence and the rest of it remains the same. The reason why both sentences can keep the same meaning is the existence of the case-marking, *O*. Although the object *boat* appears at the beginning of the sentence, Japanese speakers can identify this as an object because of the case-marking, *O*. *O* expresses the accusative case marking.

In the following sections, I therefore report two experiments that examined, firstly, whether there is a link between conceptual accessibility and word order (Experiment 1), and secondly, if conceptual accessibility influences both grammatical function assignment and word order (Experiment 2). I used the sentence recall task from Bock and Warren's study, asking participants to memorize sentences and recall them in a randomized order. I used Animacy as a measure of conceptual accessibility to see (1) if animacy influences the choice of word order (SOV 'Five people carried the boat' or OSV 'The boat (acc), five people carried') in Japanese, (2) and if it affects the processing of both grammatical function assignment (active 'Five people carried the boat' or passive 'The boat was carried by five people') and word order at the same time (SOV active and passive, OSV active and passive ('By five people the boat was carried')). While Japanese allows for argument scrambling, the SOV order is nonetheless generally preferred. Thus the expected results would be that in Experiment 1 speakers would tend to produce more inverted sentences

(e.g., OSV recalled as SOV) when the original sentence had an inanimate NP first. In addition to this, participants may produce reversed voice forms (e.g., active recalled as passive) whenever the animate NP is not the subject (Experiment 2).

If the account by Bock and her colleagues is correct that conceptual accessibility only influences grammatical function assignment (e.g., voice), then I should expect that the variation of SOV, OSV and Conjoint word orders would not be influenced by animacy. If the account by Branigan and Feleki is correct that conceptual accessibility influences the constituent structure (e.g., word order), I would expect that the serial word order would be influenced by animacy. If the third model is correct that conceptual accessibility influences both grammatical function assignment and word order simultaneously, both grammatical functions and word order in Japanese should be influenced by animacy.

3.8. Experiment 1

Participants

60 native speakers of Japanese participated. They were all recruited in the Universities of Edinburgh and Essex. 5 pounds were paid to the people who successfully completed the session. 22 participants' data were excluded because they correctly recalled the meaning of fewer than 30 % of items. It was necessary to exclude 12 participants (who recalled the meaning of fewer than 30 % of items) since the task was difficult.

Materials

To prepare the experimental materials, I carefully selected 42 animate and 42 inanimate nouns that

could be easily depicted and remained semantically the same even if animate and inanimate nouns exchanged their grammatical functions and word orders. These nouns created 6 different types of sentences (S(ani)O(inani)V, S(inani)O(ani)V, O(inani)S(ani)V, O(ani)S(inani)V, two conjuncts (animate and inanimate nouns, inanimate and animate nouns)). All together there were 252 experimental sentences.

The experimental design crossed two factors: structure (SOV, OSV, NP conjunction) and Animacy (animate-first, inanimate-first), yielding 6 conditions. The animacy of the two nouns fulfilling the subject and direct object functions was systematically manipulated. In addition to these experimental items, I added 22 fillers which were all intransitives, half of them had an animate-agent, the other half had an inanimate-agent. All the experimental sentences and filler sentences in Experiment 1 can be found in Appendix 1 and 2.

The experimental sentences had two parts – a preamble phrase (e.g., *In front of harbour*) at the beginning, and then the main clause for recall (e.g., ‘*Five people carried the boat*’). In the real experiment, 8 sets of sentences were presented at once, then preambles were heard and participants were asked to recall the rest of the sentence one by one. All the items were fully crossed within participants and items.

(45)

1... S(ani)O(inani)V

港の前で、5人の人がボートを運んだ。

minato no mae de, gonin no hito-ga booto-o hakonda.

Harbour in front of, five people-nom boat-acc carry-past

‘In front of the harbour, five people carried a boat.’

2... S(inani)O(ani)V

港の前で、ボートが5人の人を運んだ。

minato no mae de, booto-ga gonin no hito-o hakonda.

Harbour in front of, Boat-nom five people-acc carry-past

'In front of the harbour, a boat carried five people.'

3...O(inani) S(ani) V

港の前で、ボートを5人の人が運んだ。

minato no mae de, booto-o gonin no hito-ga hakonda.

Harbour in front of, boat-acc five people-nom carry-past

'In front of the harbour, a boat, five people carried.'

4...O(ani) S(inani) V

港の前で、5人の人をボートが運んだ。

minato no mae de, gonin no hito-o booto-ga hakonda.

Harbour in front of, five people-acc Boat-nom carry-past

'In front of the harbour, five people, a boat carried.'

5... conjunct (animate and inanimate)

港の前で、5人の人とボートが消えた。

minato no mae de, gonin no hito-to booto-ga kieta.

Harbour in front of, five people and boat-nom were gone.

'In front of the harbour, five people and a boat were gone.'

6... conjunct (inanimate and animate)

港の前で、ボートと5人の人が消えた。

minato no mae de, booto to gonin no hito-ga kieta.

Harbour in front of, five people and boat-nom were gone.

'In front of the harbour, boat and five people were gone.'

There was one important factor to be controlled in this experiment. The preambles had to be equally semantically associated with both nouns. For instance, if one of the nouns was semantically more related to the preamble than the other (e.g., *harbour – boat*, *harbour – plug*), one of the NPs could be more easily recalled than the other. In order to prevent this, a correlation test was conducted on 20 native speakers of Japanese, who did not participate in any other experiments that I conducted later. In a questionnaire style experiment, they were asked to judge how closely these nouns from 48 sets were associated and rate their association between 1 and 10 as below:

(46)

Harbour – people

1(unrelated) 2 3 4 5 6 7 8 9 10(very related)

Harbour - boat

1(unrelated) 2 3 4 5 6 7 8 9 10(very related)

The result of this pretest did not show any significant differences between the animate and inanimate nouns (means = 6.58, $t(47) = 0.524$, $p > .1$). 42 of these items from 48 items were selected for this experiment. There were no significant differences between these 42 items (means = 7.20, $t(41) = 0.883$, $p > .1$).

Procedure

The sentence recall task used in this experiment was similar to that used in Bock and Warren (1985) and McDonald et al. (1993). Participants were seated in a quiet room and tested individually. They were told that they would hear eight sentences in one trial from the MD audio player and they were asked to memorize them all. The order of sentences within each block was randomized. A four second pause separated each recorded sentence in each block. Then they would only hear the preamble of each sentence and participants were asked to recall the rest of the sentence as exactly as they could. The order of preambles was randomized in a different order from the original order, and participants were asked to recall the rest of each sentence within 8 seconds.

The duration of the pause between each sentence was determined on the basis of a pilot study involving three Japanese speakers who did not participate in any other experiments in this study. The point of this pilot study was to make sure if participants had enough time to answer these questions. However, it was also important to use a duration which was difficult enough to remember all the sentences verbatim. This was because this recall task was supposed to be a manipulation of language production, so I wanted to avoid the possibility of verbatim recall. The result of the pilot study suggested that four seconds (reading time) – eight seconds (answering time) was appropriate.

The sentences were divided into six different lists, and each list contained 64 sentences. Thus each block included 42 experimental items and 22 fillers (altogether, 64 sentences). Each list contained exactly one version of each item, and contained equal numbers of each condition. These sentences were divided into 8 blocks (8 x 8), so subjects memorized and recalled 8 sentences at once. Across lists, each item was seen by 8 participants in each condition.

Two blocks of eight practice sentences were presented before the main experiment to ensure that participants understood the instructions. The practice sentences consisted of two SOV sentences, two OSV sentences and two NP conjunct sentences, and fillers. Each structure had both animate patients and inanimate patients and two fillers consisted of intransitive verbs with either animate subjects or inanimate subjects. None of the sentences above were used in the actual experiment. All answers were recorded on MD audio tapes and were subsequently transcribed. The experimental session lasted half an hour.

Scoring

Participants' responses were recorded on audiotape. Participants' responses were grouped into five different categories: Correct, Word order inversion, Passive, Thematic Errors, and other errors.

1. Answers were marked as correct when participants recalled both nouns and verbs correctly, and syntactic structures (in this experiment all syntactic forms were actives or conjunct) and word order were also recalled as they were heard. Correct nouns and verbs had to be either the exact words they heard or else semantically similar (e.g., *taxi* – *car*).
2. To be marked as a word order inversion, participants recalled the correct meaning but in the alternative word order to that presented; for instance, the original SOV sentence was recalled as OSV order where NP-*o* (accusative case marker) preceded NP-*ga* (nominative case marker). That is, if participants heard '*Five people (nom) carried the boat (SOV order)*', they produced it as '*The boat (acc), five people carried (OSV order)*'. Thus both nouns with case markings exchanged their sentence positions. In order to be marked as a 'Word order inversion of NP conjunction', both nouns had to have exchange their position but the remaining sentences were exactly the same. For instance, when participants heard

'Five people and a boat were gone' (Conjunct animate-inanimate), they recalled it as *'A boat and five people were gone'* (Conjunct inanimate-animate).

3. For a thematic role error, the sentences were recalled with correct grammatical forms and word orders (SOV recalled as SOV, or OSV recalled as OSV) but the thematic roles of the nouns were switched (e.g., the original sentence *'Five people (nom) carried the boat (SOV order)'* was recalled as *'The boat (nom) carried five people (SOV)'*).
4. Passive SOVs were marked when participants heard SOV sentences and then recalled them as passive forms with the same word order and the same thematic role assignment 'NP-ga (nom) – NP-oblique – passive verbs'. (e.g., the original sentence *'Five people (nom) carried the boat (SOV active)'* was recalled as *'The boat (nom) was carried by five people (SOV passive)'*. Thus if the above sentence *'Five people (nom) carried the boat (SOV active)'* was recalled as *'Five people (nom) were carried by the boat (SOV passive)'*, it was marked as an 'other error' (which will be explained below), since it involved two different types of errors, thematic roles and passivisation.
5. Although the numbers of passivisation in Experiment 1 were small, it was possible (and grammatical) for participants to produce OSV-passive sentences since the word order of passive forms could also be changed; *'Five people (nom) were carried by the boat (SOV passive)'* as *'By the boat (NP-oblique) Five people (nom) were carried (OSV passive)'* I separately marked such answers as Passive OSVs.
6. Other errors included (a) total omission of the sentence (or no response), (b) one of the nouns were missing (c) both nouns were missing (only verbs were produced), (d) verbs were missing, (e) word order and grammatical functions were correct, but the nouns or verbs were semantically different (e.g., *boat* recalled as *pen*).
7. Only the first sentence they produced was scored. For instance, the sentence such as *'Five people went to the sea and carried the boat'* was excluded from correct answers and counted as other errors.
8. Any sentences containing verbs which expressed actions done by the object (animate or inanimate)

were counted as other errors. Such sentences could be like (47) below:

(47)

ボートを運んでいる 5 人の人たち

Booto o hakonde-iru gonin no hito

Boat-acc carry-ing five people

'Five people carrying the boat'

In this study, as in Bock and colleagues' experiments, I examined the proportion of word order inversions. As described above, inverted sentences were ones which were recalled in a different form to that presented, when the semantic content was correctly remembered. For example, an SOV order might have been misrecalled as an OSV order, or nouns in a conjunction exchanged their positions. As I examined the proportion of word order inversions, I was able to see the reflection of word order preferences. Following Bock and Warren (1985), I computed the relevant proportions by dividing the numbers of inverted answers by the total numbers of responses where the meaning was correctly recalled (i.e., the sum of correct and inverted responses). These proportions were calculated for each participant and each item. I carried out analyses of variance (ANOVAs) with separate analyses which treated participants (F1) and items (F2) as random effects. Both analyses were within-participants and within-items. In this analysis, I only looked at word order inversion and did not analyse other types of errors since other numbers were too small to analyse.

3.9. Results of Experiment 1

Analyse of variance (ANOVA) revealed a main effect of animacy ($F(1,47) = 10.32$, $MSe = 0.354$, p

= .002; $F_2(1.41) = 11.73$, $MSe = 0.680$, $p < .001$) and word order ($F_1(1,47) = 72.63$, $MSe = 5.212$, $P < .001$; $F_2(1.41) = 71.18$, $MSe = 4.240$, $p < .001$). Inspection of table 2 suggests that participants were more likely to recall sentences with the alternative order when the result was to place the animate entity first (26.3%) than when it was to place the inanimate entity first (17.2%). These analyses suggested that participants were more likely to recall (1) animate NPs earlier than inanimate NPs in general, (2) sentences in an alternative form to that originally presented when this resulted in the preferred SOV order than when it resulted in an OSV order. Table 1 shows all responses in each condition in Experiment 1 and Table 2 shows the proportion of Correct and Word order inversion responses in Experiment 1. Figure 7 shows the proportion of word order inversions in Experiment 1.

Table 1. All responses in experiment 1

<i>Recalled responses</i>	Correct	Word order inversion	Errors		Passive	
			Others	Thematic	SOV	OSV
<i>Original sentences</i>						
An-In-SOV	189	5	139	2	1	0
In-An-SOV	164	8	150	10	3	1
An-In-OSV	84	49	155	34	14	0
In-An-OSV	76	96	146	14	4	0
An-In-Conj	151	21	162	1	1	0
In-An-Conj	150	32	154	0	0	0

Note. Abbreviation: Correct = Correct Response, Word order inversion – simple word order change, Other Errors – errors include incomplete sentences, total omission.; Thematic error =Thematic Role Error, Pas SOV – recalled as Passive SOV order, Pas OSV – recalled as Passive OSV order.

Table 2. Proportion of Correct and Word order inversion responses in Experiment 1

<i>Recalled responses</i>	Correct	Word order inversion
<i>Original sentences</i>		
An-In-SOV	0.97	0.03
In-An-SOV	0.95	0.05
An-In-OSV	0.63	0.37
In-An-OSV	0.44	0.56
An-In-Conj	0.88	0.12
In-An-Conj	0.82	0.18

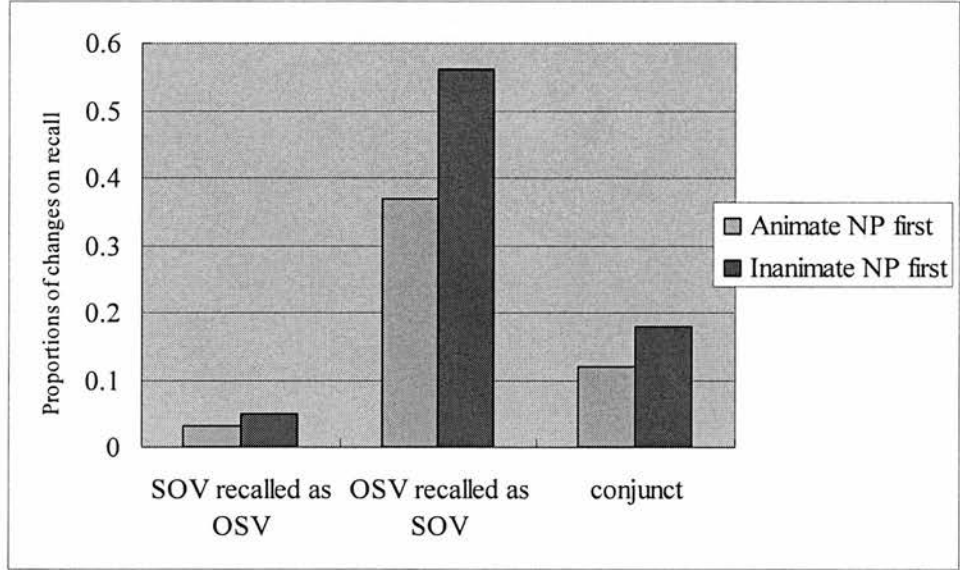


Figure 7. Overall proportion of word order inversion (correct meaning but changes in form) in Experiment 1.

There was an interaction between animacy and structure (marginal by participants, $F_1(1.47) = 2.95$, $MSe = 0.119$, $p = .066$; $F_2(1.41) = 7.82$, $MSe = 0.339$, $p < .001$). In detail, planned comparisons revealed that there was a significant difference between animate-inanimate OSV and inanimate-animate OSV

($F(1,47) = 7.49$, $MSe = 0.053$, $p = .009$; $F(1,41) = 13.01$, $MSe = 0.069$, $p < .001$), but no such differences were shown in SOV ($F(1,47) = 0.08$, $p > .1$, $MSe = 0.018$; $F(1,41) = 1.31$, $MSe = 0.016$, $p > .1$) and Conjunct structures ($F(1,47) = 1.69$, $MSe = 0.049$, $p < 1.0$; $F(1,41) = 1.03$, $MSe = 0.043$, $p < 1.0$). These analyses showed that participants were more likely to recall OSV sentences as SOV sentences when inanimate NPs appeared earlier than animate NPs (55.8%), than when animate NPs appeared earlier than inanimate NPs (36.8%).

In order to justify this result, I examined the proportions of other errors and thematic role errors. As I examined the proportions of other errors and thematic role errors, I was able to see that the current results were not due to the numbers of errors. I computed the relevant proportions by dividing the numbers of other errors and thematic role errors by the total numbers of responses. These proportions were calculated for each participant and each item. I carried out analyses of variance (ANOVAs) with separate analyses which treated participants (F1) and items (F2) as random effects. Both analyses were within-participants and within-items.

First of all, ANOVAs on the proportion of other errors revealed that none of the effects achieved significance (All $F_s < 1$). Secondly, ANOVAs on the proportion of thematic role errors revealed no main effect of Animacy ($F(1,47) = 2.61$, $MSe = 0.012$, $p > .1$; $F(1,41) = 1.47$, $MSe = 0.022$, $p > .1$). However, the main effect of word order was significant ($F(1,47) = 33.35$, $MSe = 0.128$, $p < .001$; $F(1,41) = 5.11$, $MSe = 0.155$, $p < .008$). Inspection of Table 3 showed that the participants were more likely to produce thematic role errors when they recalled OSV orders (7%) than SOVs (2%) and Conjuncts (0.5%). Given the fact that OSV orders are less frequent in Japanese, it is not surprising that people tend to produce more errors on OSVs.

There was an interaction between animacy and word order (only F1 was significant; $F(1,47) = 8.81$, $MSe = 0.012$, $p < .001$; $F(1,41) = 2.76$, $MSe = 0.016$, $p < .069$). In detail, planned comparisons revealed that there was a significant difference between animate-inanimate OSV and inanimate-animate OSV ($F(1,47) = 8.58$, $MSe = 0.020$, $p < .005$; $F(1,41) = 4.87$, $MSe = 0.026$, $p < .033$), but no such differences were shown in SOV ($F(1,47) = 5.88$, $MSe = 0.010$, $p < .019$; $F(1,41) = 1.73$, $MSe = 0.025$, $p < .195$) and Conjunct structures ($F(1,47) = 1.00$, $MSe = 0.003$, $p < .322$; $F(1,41) = 1.07$, $MSe = 0.032$, $p < .306$). Inspection of Table 3 suggested that participants were more likely to produce thematic role errors on animate-patient and inanimate-agent orders on OSVs (10%) than inanimate-patient and animate-agent orders on OSVs (4%). As before, such a result is not surprising since SOV order is preferred, and animate entity is likely to be assigned as a subject and people tend to produce more thematic role errors on animate-inanimate OSV orders. Table 3 shows the proportions of other errors and thematic role errors in Experiment 1.

Table 3. Proportions of other errors and thematic role errors in Experiment 1

<i>Recalled responses</i>	Other errors	Thematic role errors
<i>Original sentences</i>		
An-In-SOV	0.41	0.01
In-An-SOV	0.45	0.03
An-In-OSV	0.46	0.10
In-An-OSV	0.43	0.04
An-In-Conj	0.48	0.01
In-An-Conj	0.46	0.00

3.10. Discussion of Experiment 1

The results of Experiment 1 confirmed that, first of all, there was a strong tendency to use SOV orders irrespective of animacy. This means that there was no tendency for SOV orders to be recalled as OSV irrespective of animacy. Secondly, there was a strong tendency to recall OSV order as SOV. These two results together showed that there was a strong overall preference for SOV order. However in OSV cases, participants produced more inversions when the effect of word order inversion was to place an animate entity in first position (animate entities recalled first, 55.8%; inanimate entities recalled first, 36.8%). This result strongly suggests that conceptual accessibility affects word-order. This is inconsistent with Bock and Warren's finding. In addition, Bock and Warren (1985) examined NP conjuncts to investigate the effect of pure word order and failed to find any tendency for subjects to produce animate nouns earlier than inanimate ones in conjuncts. They concluded that since they could not find any consistent word order change in English NP conjuncts related to animacy, there was no animacy effect on word order. However, the results of the current study also showed no effect of animacy on two conjuncts. In contrast, we did get effects of OSV orders, suggesting that Japanese speakers did show some word order effects associated with animacy. Thus, this furthermore suggested that conjunct sentences might not be good examples for testing word order effects. As I discussed in the introduction, there have been some conflicts about the experimental results regarding the effect of conceptual accessibility on NP conjunctions. Even though Bock and Warren (1985) and McDonald et al. (1993) did not find any accessibility effects on NP conjunctions, there have been several studies which found such effects. Cooper and Ross (1975) showed that there is a tendency for an animate entity preceding an inanimate entity in such a frozen order (e.g., *horse* and *buggy*). Byrne and Davidson (1985) found that children tended to remember *horse* – *cart* name orders (in other words animate-inanimate orders) better than *cart* – *horse* name orders (inanimate – animate orders). Apart from animacy, Kelly et al. (1986) investigated the effect of prototypicality as an index of conceptual

accessibility on NP conjunctions and they found that their participants recalled sentences with more prototypical words (e.g., *red, beer*) preceding non-prototypical words (e.g., *gold, rye*) in conjuncts. Thus it is hard to conclude from these facts that conjunctions manifest true effects of word order.

This effect was much clearer when I compared the percentage of word order inversions in both OSV and conjuncts. It is also worth mentioning that these results may suggest that incremental processing might be temporally suspended in the processing of conjunctions (see Branigan & Feleki, 1999). I will discuss this in the last part of this chapter. In sum, these results suggest that animacy does play a role in word order, and these furthermore indicate that the absence of word order effects in NP conjunctions may not be taken as the evidence for the absence of word order effects on other word order structures (such as OSV in Japanese).

However, from the results of Experiment 1, I cannot be sure whether conceptual accessibility as indexed by animacy influences grammatical functional assignment, particularly in Japanese. Branigan and Feleki (1999) pointed out that conceptual accessibility might have an affinity for higher grammatical functions, in addition to early serial positions. Clearly Experiment 1 did not simply test such a possibility. In the next section, I will present another experiment which aimed to test both grammatical function and word order effects.

3.11. Animacy, word-order and voice

As I discussed in the previous section, it is clear that Experiment 1 in Japanese showed that conceptual accessibility such as animacy can influence the choice of word order in Japanese. However, it is still possible to point out that I cannot draw any conclusions from Experiment 1 about where there is an effect of grammatical function assignment too. This is simply because I did not test such a possibility in Experiment

1. It is also important to note that the existing models of language production (Bock & Levelt, 1994; Levelt, 1989; Garrett, 1980) assume that functional assignment takes place at the functional level, and word order variation is determined at the positional level, and more importantly, they predict that the functional level will be processed after conceptualization, then the positional level will be processed afterwards. Under this assumption, it is assumed that conceptual information will influence only the processing of the functional level. Clearly this assumption does not suit the results of Experiment 1, since word order in Japanese is clearly influenced by variations in animacy. Thus it is possible to suggest that existing models of language production would not be able to explain such effects. However, it is also true that Experiment 1 did not examine whether animacy also influences grammatical function assignment in Japanese. Therefore, in order to explore that animacy would influence both grammatical function assignment and word order, I will adopt the Japanese language once more and explore the possibility of animacy influence on grammatical encoding furthermore.

3.12. Passive in Japanese

This section provides an overview of the characteristics of Japanese passivisation. The basic expression of Japanese passive sentences requires the passive verb form and the oblique phrase '*niyotte*' or '*ni*'. The interesting point is, there is also the possibility of scrambling word order in Japanese passive sentences, as in (48-a) and (48-b). Note that in Japanese, both '*niyotte*' and '*ni*' can be used as an oblique marker. I chose the oblique '*niyotte*' instead of simple '*ni*' in Experiment 2, because this is the formal style and it would be easier for our participants to realise the passive forms.

(48)

a. S O(obl)V-passive

ボートが 5 人の人によって (に) 運ばれた。

booto-ga Gonin no hito niyotte hakobare-ta

boat-nom five people-obl carry-passive-past

'The boat was carried by five people.'

b. O(obl) S V-passive

5 人の人によって (に) ボートが運ばれた。

Gonin no hito niyotte booto-ga hakobare-ta.

Five people-obl boat-nom carry-passive-past

'By five people, the boat was carried.'

To avoid confusion, I will call NP-*ga* (nominative case marking) the subject, irrespective of whether it appears in an active or passive structure. I will call NP-*o* (accusative case marking) and NP-*niyotte* (oblique-by phrase) the object.

In example (49), the NP phrase '*booto*' (boat) with its oblique phrase '*booto niyotte* (by the boat)' could be placed at the front of the sentence, but the sentence would still remain the same in terms of the assignment of thematic roles to grammatical functions. Thus here, I can make a direct comparison between three factors – animacy (animate-inanimate), word order (SOV-OSV) and voice (active-passive). This is particularly useful because what I need is to test both the effects of grammatical function assignment and word order:

(49) Examples of 8 Japanese sentences tested in experiment

1... S(ani)O(inani)V

港の前で、5 人の人がボートを運んだ。

minato no mae de, gonin no hito-ga booto-o hakonda.

Harbour in front of, five people-nom boat-acc carry-past

'In front of the harbour, five people carried the boat.'

2... S(inani)O(ani)V

港の前で、ボートが5 人の人を運んだ。

minato no mae de, booto-ga gonin no hito-o hakonda.

Harbour in front of, Boat-nom five people-acc carry-past

'In front of the harbour, the boat carried five people.'

3...O(inani)S(ani)V

港の前で、ボートを5 人の人が運んだ。

minato no mae de, booto-o gonin no hito-ga hakonda.

Harbour in front of, boat-acc five people-nom carry-past

'In front of the harbour, the boat, a five people carried.'

4...O(ani)S(inani)V

港の前で、5 人の人をボートが運んだ。

minato no mae de, gonin no hito-o booto-ga hakonda.

Harbour in front of, five people-acc Boat-nom carry-past

'In front of the harbour, a five people, the boat carried.'

5... S(ani)O(inani)-oblique V [passive]

港の前で、5 人の人がボートによって運ばれた。

minato no mae de, gonin no hito-ga booto-niyotte hakobareta.

Harbour in front of, five people-nom boat-obl carry-pas-past

'In front of the harbour, five people were carried by the boat.'

6... S(inani)O(ani)-oblique V [passive]

港の前で、ボートが5 人の人によって運ばれた。

Minato no mae de, booto-ga gonin no hito-niyotte hakobareta.

Harbour in front of, Boat-nom five people-obl carry-pas-past

'In front of the harbour, the boat was carried by five people.'

7...O(inani) -oblique S(ani) V [passive]

港の前で、ボートによって5 人の人が運ばれた。

Minato no mae de, booto-niyotte gonin no hito-ga hakobareta.

Harbour in front of, boat-obl five people-nom carry-pas-past

'In front of the harbour, by the boat, five people were carried.'

8...O(ani) -oblique S(inani) V [passive]

港の前で、5 人の人によってボートが運ばれた。

minato no mae de, gonin no hito-niyotte booto-ga hakobareta.

Harbour in front of, five people-obl Boat-nom carry-pas-past

'In front of the harbour, by five people, the boat was carried.'

According to the findings of Experiment 1, which suggested that conceptual accessibility affects the production of different word orders in transitive sentences (e.g. OSV vs. SOV), I would expect the same findings for both active and passive sentences. First of all, as Experiment 1 showed, SOV order should be generally a preferable word order, therefore I would expect that participants would not invert the SOV word order, irrespective of animacy. Secondly, however, when OSV orders are presented, participants may produce alternative word orders (SOV). In particular, OSV sentences with conceptually less accessible nouns (inanimate NPs) in the object function may be produced more as SOV sentences than OSV sentences with animate nouns in the object function. In addition, in both cases I would expect the same findings irrespective of voice change.

For the choice of voice, I hypothesise, following Bock and Warren (1985) and McDonald et al. (1993), that conceptual accessibility is highly associated with grammatical role assignment. According to Bock and Warren's hypothesis, which is that there is a possible link between animacy and subjecthood, conceptually accessible nouns would preferably be assigned the subject function. If conceptually accessible nouns are not assigned the subject function (e.g., '*The boat carried five people.*'), active/passive sentences would become passive/active, irrespective of word order in Japanese (SOV/OSV).

Therefore, I tested whether conceptual accessibility would influence both grammatical function assignment and word order by using SOV/OSV and Active/Passive sentences in Japanese. If Bock and her colleagues' hypothesis (Bock & Warren, 1985; McDonald et al., 1993) is correct, I would expect participants tend to recall sentences in a form that allowed conceptually more accessible entity to occur in subject position. Thus sentences such as actives ('*The boat carried five people.*') should be recalled as passives ('*Five people were carried by the boat.*'), and sentences such as passives should be recalled as actives. If Branigan and Feleki's hypothesis (e.g., Branigan and Feleki, 1999) is correct, I would expect

participants to recall sentences in a form that allowed the conceptually more accessible entity to appear first, irrespective of grammatical function. Thus sentences with SOV order (e.g., ‘*The boat carried five people.*’) should be recalled as OSV (‘*Five people (acc), the boat carried.*’), and sentences with OSV order should be recalled as SOV. If the current hypothesis that both grammatical function assignment and word order influenced by animacy is correct, then I would expect participants to recall sentences in a form that allowed the conceptually more accessible entity to appear first, as Branigan and Feleki suggested, and also to be assigned the subject function, as Bock and Warren suggested.

3.13. Experiment 2

Participants

I recruited 90 participants who were all Japanese native speakers from Japan. They did not participate in any other experiments that I conducted in this thesis. 18 participants’ data were excluded because they correctly recalled the meaning of the sentence in fewer than 30 % of sentences.

Materials

I re-used the 42 pairs of animate/inanimate nouns from Experiment 1, plus the 6 other pairs of animate/inanimate nouns that I pretested for Experiment 1. It is important to recall that the pretest showed that there were no differences between animate and inanimate set. So altogether there were 48 items in Experiment 2; the results of the pretest in Experiment 1 showed that there were no differences in the semantic relatedness of the animate versus inanimate nouns to the preamble. The original items in Experiment 1 were changed into actives plus passives (as in Example (44), p.69). I created items by fully

crossing subject (animate vs. inanimate), word order (SOV vs. OSV) and voice (active vs. passive). Each items contained 8 different types of sentences. Altogether there were 384 experimental items. In addition, there were 24 fillers (transitive sentences). As in Experiment 1, half of the fillers were 12 intransitive sentences with animate-agents, and half of them were 12 inanimate-agent intransitives. All the experimental sentences and filler sentences in Experiment 1 can be found in Appendix 3 and 4.

Procedure

I used the same method as in Experiment 1. However, since I added 6 more experimental items, there were 48 sets of experimental items. I created 8 lists, each containing 72 sentences (48 experimental items and 24 fillers). These sentences were divided into 9 blocks of 8 sentences, so subjects memorized and recalled 8 sentences at once. Each item appeared in each list in one condition; across lists, each item was seen by 9 participants in each condition. Items were presented in a fixed random order.

The experimental session started with a practice block, and all the answers were recorded on Mini Disk audio tapes and subsequently transcribed. The experimental session lasted 40 minutes.

Scoring

Participants' responses were marked in a similar way as in Experiment 1, but in Experiment 2 I grouped them into 6 different categories: Correct, Word order inversion, Voice inversion, and Word order + Voice inversion, Thematic Errors, and Other errors.

1. Correct, Word order inversion, thematic role errors and other errors were scored in the same way as

they were in Experiment 1.

2. To be scored as Voice inversion, participants recalled the sentences with the opposite voice to the voice of the sentence that they originally heard. However, thematic roles had to be correctly recalled. Hence if an active sentence was recalled as a passive, or a passive as an active, this was scored as Voice Inversion, as long as the original word order (SOV or OSV) was maintained.
3. To be marked as word order inversion + voice inversion, participants changed both the voice and word order of the sentence they recalled. For instance, the original sentence may have been SOV active sentence '*Five people carried the boat*', but participants recalled it as OSV passive sentence '*By five people, the boat was carried*'. In this case, both word order inversion (SOV to OSV) and voice inversion (active to passive) occurred.
4. The rest of the coding rules were exactly the same as in Experiment 1.

As described previously, inverted sentences were ones which were recalled in a different form (SOV to OSV, or OSV to SOV) to that presented, and voice inverted sentences were ones which were recalled in a different voice form (active-passive, passive-active). As I examined the proportion of word order inversions and voice inversions, I was able to identify overall word order and voice preferences. I computed the relevant proportions for word order inversions by dividing the numbers of inverted answers by the total numbers of the four responses (correct answers, word order inversion answers, voice inversion answers, and voice and inversion answers); for voice inversion by dividing the numbers of voice inversions by the total numbers of the four responses; and for word order inversion + voice inversion by dividing the numbers of word order inversions and voice inversion by the total numbers of the four responses. These proportions were calculated for each participant and each item. In the current study I carried out analyses of variance (ANOVAs) with separate analyses which treated participants (F1) and items (F2) as random effects. Both analyses were within-participants and within-items.

3.14. Results of Experiment 2

3.14.1. Results of word order inversions

In this experiment, I focused only on the analyses of the proportions of word order inversion and voice inversion. Since the total numbers of ‘word order and voice inversions’ were small to analyse, the analysis of proportions of word order and voice inversions was excluded. Table 4 shows all responses in each condition in Experiment 2 and Table 5 shows the proportion of Correct and Word order inversion, voice inversion and word order and voice inversion responses in Experiment 2.

The same analyses were performed as in Experiment 1. Analyses of variance treating both participants and items as random effects revealed main effects of animacy and word order (animacy: $F(1,71) = 20.61$, $MSe=1.298$, $p<.001$; $F(1, 47) = 27.63$, $MSe=1.008$, $p<.001$; word order: $F(1,71) = 92.81$, $MSe=4.855$, $p<.001$; $F(1, 47) = 82.66$, $MSe=2.783$, $p<.001$), suggesting once again that participants were more likely to recall (1) animate NPs earlier than inanimate NPs in general, (2) SOV sentences in the alternative word order to that originally presented when this resulted in SOV order than in OSV order.

In addition, there was also an effect of voice (marginal F1 effect, $F(1,71) = 3.86$, $MSe=0.194$, $p<.053$; $F(1, 47) = 6.96$, $MSe=0.200$, $p<.01$). Inspection of Table 4 shows that participants were more likely to recall actives as passives (72%) than to recall passives as actives (60%). Thus the effect of voice suggested that overall passive sentences were preferred compared to actives.

There were also significant interactions of animacy by word order (SOV or OSV) ($F(1,71) = 26.43$, $MSe=0.938$, $p<.001$; $F(1, 47) = 23.59$, $MSe=0.648$, $p<.001$) and Word order by voice ($F(1,71) = 53.52$,

MSe=3.142, $p<.001$; $F2(1, 47) = 59.00$, MSe=2.0641, $p<.001$). This means that the tendency to recall animate entities first was affected by word order, as there was a stronger tendency for OSV orders to be recalled as SOV orders (animate-inanimate to inanimate-animate: 31%, inanimate-animate to animate-inanimate: 68%) than SOV orders to be recalled as OSV orders (animate-inanimate to inanimate-animate: 12%, inanimate-animate to animate-inanimate: 15%). It also suggested that the tendency to recall passives as actives was affected by word order: OSV-actives were recalled as OSV-passives (69%) more than SOV-actives were recalled as SOV-passives (3%), and OSV-passives were recalled as OSV-actives (31%) more than SOV-passives were recalled as SOV-actives (24%).

Planned comparisons confirmed that although there were no animacy effects for SOV sentences in either actives or passives (actives: $F1(1,71) = .11$, MSe=0.100, $p>.1$; $F2(1, 47) = .02$, MSe=0.010, $p>.1$, passives: $F1(1,71) = 1.09$, MSe=0.030, $p>.1$; $F2(1, 47) = 1.50$, MSe=0.032, $p>.1$), there was a clear animacy effect for OSV sentences in both actives and passives (actives: $F1(1,71) = 10.58$, MSe=0.055, $p<.002$; $F2(1, 47) = 24.50$, MSe=0.049, $p<.001$, passives: $F1(1,71) = 22.13$, MSe=0.037, $p<.001$; $F2(1, 47) = 14.70$, MSe=0.033, $p<.001$).

None of the other effects achieved significance. In particular, there was no animacy by voice interaction ($F1(1,71) = .17$, MSe=0.008, $p>.1$; $F2(1, 47) = 1.65$, MSe=0.033, $p>.1$). Figure 8 shows the proportion of word order inversions in Experiment 2.

Table 4. Raw numbers of each responses in Experiment 2

Recalled responses	Correct	Inversion			Errors	
		Word order	Voice	Word order and Voice	Others	Thematic
original sentences						
S(An)-O(In)-act	271	5	6	2	143	5
S(In)-O(An)-act	212	4	39	18	149	10
O(An)-S(In)-act	67	48	87	9	177	44
O(In)-S(An)-act	98	115	29	10	157	23
S(An)-O(In)obl-pas	219	25	6	6	169	7
S(In)-O(An)obl-pas	183	37	17	33	149	13
O(An)obl-S(In)-pas	137	20	86	1	182	6
O(In)obl-S(An)-pas	153	56	41	1	164	17

Note: Abbreviation: Correct – correct answer, Word order inversion – inversion answer, Voice inversion – voice inversion answer, word order inversion + voice inversion – word order and voice inversion, Errors – error answer, Thematic role error – thematic error answer.

Table 5. The proportions of each responses in Experiment 2

<i>Recalled responses</i>	Correct	Inversion		
		Word order	Voice	Word order and Voice
<i>original sentences</i>				
S(An)-O(In)-act	0.95	0.02	0.02	0.01
S(In)-O(An)-act	0.78	0.01	0.14	0.07
O(An)-S(In)-act	0.32	0.23	0.41	0.04
O(In)-S(An)-act	0.39	0.46	0.11	0.04
S(An)-O(In)obl-pas	0.86	0.1	0.02	0.02
S(In)-O(An)obl-pas	0.68	0.14	0.06	0.12
O(An)obl-S(In)-pas	0.56	0.08	0.35	0.01
O(In)obl-S(An)-pas	0.61	0.22	0.16	0.01

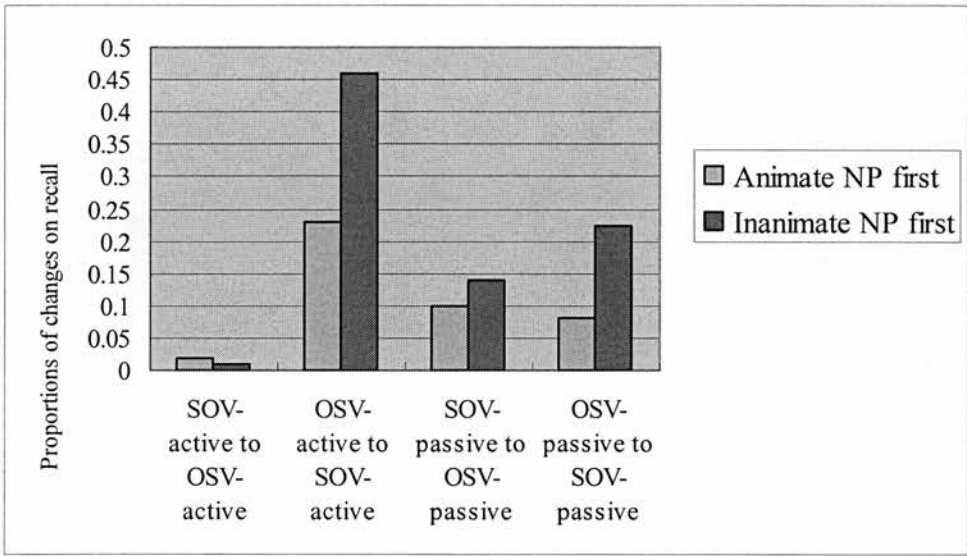


Figure 8. Proportion of Word order inversions in Experiment 2

3.14.2. Results of voice inversion change

Separate analyses of variance (ANOVA) treating both participants and items as random effects revealed main effects of animacy and word order (animacy: $F(1, 71) = 15.73$, $MSe = 0.737$, $p < .001$; $F(1, 47) = 38.20$, $MSe = 0.930$, $p < .001$; word order: $F(1, 71) = 112.20$, $MSe = 5.746$, $p < .001$; $F(1, 47) = 113.41$, $MSe = 3.994$, $p < .001$). These suggested that (1) participants were more likely to produce animate NPs in the subject function than in the object function regardless of sentence forms, (2) SOV forms were overall preferred to OSV forms regardless of voice. Other effects suggested that animate entities generally appeared to be in the subject function for both word orders (SOV or OSV) (Animacy by word order, $F(1, 71) = 65.40$, $MSe = 3.458$, $p < .001$; $F(1, 47) = 76.33$, $MSe = 2.874$, $p < .001$), and this effect was still significant when voice was included in the analyses (active or passive) (animacy by word order by voice, $F(1, 71) = 7.35$, $MSe = 0.397$, $p < .008$; $F(1, 47) = 9.28$, $MSe = 0.282$, $p < .004$).

There was a significant effect of animacy by word order ($F(1, 71) = 65.40$, $MSe = 3.458$, $p < .001$; $F(1, 47) = 76.33$, $MSe = 2.874$, $p < .001$).

(1, 47) = 76.33, MSe = 2.874, $p < .001$), suggesting that the tendency to put animate entities in subject function varied according to whether the word order was SOV or OSV. Inspection of Table 4 suggests that there was a stronger tendency for OSV orders to be recalled as SOV orders (animate-inanimate to inanimate-animate: 76%, inanimate-animate to animate-inanimate: 27%) than SOV orders to be recalled as OSV orders (animate-inanimate to inanimate-animate: 4%, inanimate-animate to animate-inanimate: 20%). There was also a three-way interaction between animacy, word order and voice. This three way interaction means that the animacy effect was influenced by both word order and voice (animacy by word order by voice, $F(1, 71) = 7.35$, MSe = 0.397, $p < .008$, $F(1, 47) = 9.28$, MSe = 0.282, $p < .004$). In detail, planned comparisons confirmed that both word orders showed an effect of voice (SOV: actives; $F(1, 71) = 19.15$, MSe = 0.029, $p < .001$; $F(1, 47) = 16.85$, MSe = 0.028, $p < .001$, passives; $F(1, 71) = 4.60$, MSe = 0.018, $p < .035$; $F(1, 47) = 3.06$, MSe = 0.020, $p < .087$; OSV; actives: $F(1, 71) = 34.42$, MSe = 0.049, $p < .001$; $F(1, 47) = 64.82$, MSe = 0.042, $p < .001$, passives: $F(1, 71) = 14.93$, MSe = 0.043, $p < .001$; $F(1, 47) = 23.88$, MSe = 0.041, $p < .001$).

No other effects approached significance. In particular, there was no main effect of voice ($F(1, 71) = .88$, MSe = 0.064, $p > .1$; $F(1, 47) = .3.17$, MSe = 0.153, $p < .082$), animacy by voice ($F(1, 71) = .01$, MSe = 0.007, $p > .1$; $F(1, 47) = 1.02$, MSe = 0.020, $p > .1$), or word order by voice ($F(1, 71) = 2.37$, MSe = 0.108; $p > .1$, $F(1, 47) = .30$, MSe = 0.007, $p > .1$). Figure 8 shows the proportions of voice inversion in Experiment 2.

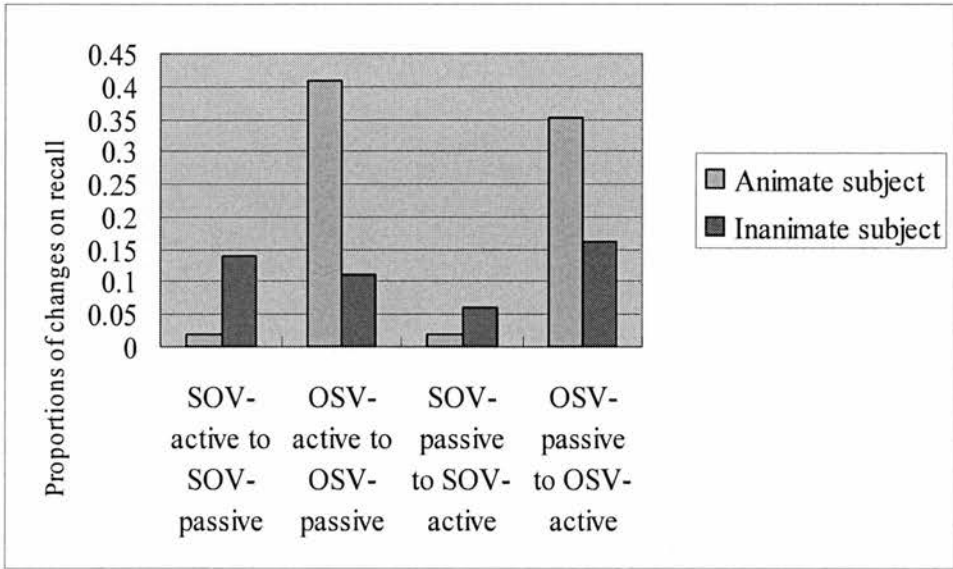


Figure 9. The proportion of voice inversion changes in Experiment 2

As in Experiment 1, in order to justify this result, I examined the proportions of other errors and thematic role errors. These results showed that the current results were not due to the numbers of errors. I computed the relevant proportions by dividing the numbers of other errors and thematic role errors by the total numbers of responses. These proportions were calculated for each participant and each item. I carried out analyses of variance (ANOVAs) with separate analyses which treated participants (F1) and items (F2) as random effects. Both analyses were within-participants and within-items. However, since the total numbers of ‘thematic role errors’ were small to analyse, the analysis of proportions of thematic role errors was excluded.

ANOVAs on the proportion of other errors revealed main effects of animacy ($F(1,71) = 10.74$, $MSe = 0.234$, $p < .002$; $F(1,47) = 4.15$, $MSe = 0.087$, $p < .047$) and word order ($F(1,71) = 3.84$, $MSe = 0.106$, $p < .054$; $F(1,47) = 8.05$, $MSe = 0.158$, $p < .007$). Inspection of table 6 showed two points: firstly, the participants were more likely to produce other errors when they recalled animate-inanimate orders (38.6%)

than inanimate-animate orders (34.6%). However, when it was animate-inanimate order, participants produced more errors when animate entities were objects than (41.5%) when they were subjects (36%). Thus it is consistent with the current finding that animate entities tend to place in the subject positions. Secondly, the participants were more likely to produce other errors when they recalled OSV orders (37.9%) than SOVs (35.2%). As in Experiment 1, it is unsurprising that people tend to produce more errors on OSVs because OSV orders are less frequent in Japanese. None of the other effects achieved significance (All $F_s < 1$).

Table 6. Proportions of other errors and thematic role errors in Experiment 2

<i>Recalled responses</i>	Other errors	Thematic role errors
<i>original sentences</i>		
S(An)-O(In)-act	0.33	0.01
S(In)-O(An)-act	0.34	0.02
O(An)-S(In)-act	0.41	0.10
O(In)-S(An)-act	0.33	0.01
S(An)-O(In)obl-pas	0.39	0.02
S(In)-O(An)obl-pas	0.35	0.03
O(An)obl-S(In)-pas	0.42	0.01
O(In)obl-S(An)-pas	0.36	0.05

3.15. Summary of Experiment 2

The results of Experiment 2 confirmed that, first of all, as Experiment 1 showed, SOV order should be generally a preferable word order, therefore participants did not invert the SOV word order, irrespective of animacy. Secondly, however, when OSV orders were presented, participants tended to produce alternative word orders (SOV). In particular, OSV sentences with conceptually less accessible nouns (inanimate NPs)

in object function were produced more as SOV sentences than OSV sentences with animate nouns in object function. In addition, in both cases I found the same findings irrespective of voice change.

For the choice of voice, the results were consistent with Bock and Warren (1985)'s and McDonald et al. (1993)'s proposal that conceptual accessibility is highly associated with grammatical role assignment. Thus, there is a possible link between animacy and subjecthood, with conceptually accessible nouns being preferably assigned the subject function. When conceptually accessible nouns were not assigned the subject function (e.g., '*The boat carried five people.*'), active/passive sentences were recalled as passive/active, irrespective of word order in Japanese (SOV/OSV). In sum, it seems that such results support the third model of grammatical encoding in which animacy does play a role in the determination of both word order and grammatical function assignment.

3.16. General discussion

As seen, experiments 1 and 2 confirmed that conceptual accessibility affects language production in Japanese, in terms of both grammatical function assignment and serial word order. The previous findings by Bock and her colleagues (Bock & Warren, 1985 and McDonald et al., 1993) or Branigan and Feleki (1999) cannot explain the results of the current studies, since their studies only focused on either grammatical function assignment effect or serial word order effects. What was found in this study was that when speakers produce sentences containing conceptually more accessible nouns the temporally activated and accessible nouns tend to be produced earlier than conceptually less accessible ones. As a result, conceptual accessibility seems to affect syntax in two ways – grammatical function assignment (leading to choice of active versus passive voice), and word order (such as SOV or OSV).

Compared to the reviewed empirical studies (Bock & Warren, 1985; McDonald et al., 1993; Branigan & Feleki, 1999), the results of the current studies showed a new insight into animacy effects on production. Firstly, Bock and Warren (1985) examined NP conjunctions to investigate the effect of word order and failed to find a tendency for participants to produce animate nouns earlier than inanimate ones in conjuncts. In contrast, the results of our Experiment 1 showed that word order in Japanese OSV sentences was strongly affected by animacy, but word order in NP conjunctions was not. These results indicate that word order for NP conjunctions could be unusual and that the processing of NP conjunctions may be rather complex (Chomsky, 1957; Gazdar et al., 1985) and may be different from processing in normal declarative sentences (Branigan & Feleki, 1999). As I discussed in the previous section, there have been some conflicting results, with some researchers suggesting that conceptual accessibility affects the choice of order in NP conjunctions (Cooper & Ross, 1975; Byrne & Davidson, 1985; Kelly et al., 1986), but some others have suggested that it does not (Bock & Warren, 1985 and McDonald et al., 1993).

However, the current studies made this issue very clear – when I manipulated the animacy of NP conjunctions (animate-inanimate or inanimate-animate order), there was no effect of conceptual accessibility on NP conjunctions in Japanese, although I clearly showed that in declarative sentences (OSV in this case) animacy influenced word order variation in Japanese. Such a phenomenon could be explained by Branigan and Feleki (1999) and Branigan, Pickering and Tanaka (2008), who claimed that there may be a temporal suspension of incremental processing of NP conjunctions. For instance, in normal declarative sentences the processor can decide the syntactic processing of each noun as it retrieves it. However, in NP conjunctions it has to retrieve two nouns before the syntactic processing in conjunct phrases can be decided. Thus related to the complexity of conjunct processing, it would be plausible that the processing of NP conjunction could be temporally suspended, and participants would produce conjuncts only once they have retrieved both nouns (Branigan & Feleki, 1999; Branigan et al., 2008).

More importantly, the results of the current studies indicate two important implications for models of language production. First of all, the results of current studies are compatible with the hypothesis of incremental model of language production (e.g., de Smedt, 1990; Levelt, 1989; Bock & Levelt, 1994; Levelt et al., 1999). The current findings showed that conceptually more accessible nouns (such as animate nouns) are produced earlier than less accessible nouns (such as inanimate nouns). In my experiments, this effect affected people's choice of SOV vs. OSV, or active vs. passive structures. Such a pattern is consistent with an incremental account of language production, in which the processor deals with fragments of information as and when they become available and processing of different aspects of structure takes place simultaneously. Thus, speakers can generate and articulate an utterance as soon as minimal input is available, rather than it waits until all the information is available (e.g., de Smedt, 1990).

Secondly, it is also important to discuss how these data from recall experiments are captured within a model of language production. To recall, I discussed in chapter 2 that existing models of grammatical encoding suggest that functional processing takes place directly after the processing of conceptualization, then positional processing takes place subsequently. However, Kempen and Harbusch (2004) suggested that such a model cannot explain why serial order would be influenced by animacy, and they furthermore claimed that there should be a more flexible grammatical encoding structure that can explain the results of their study. The results of the current study (Experiment 2) also showed that animacy influences not only word order, but also simultaneously grammatical role assignment. Thus if I follow the current models of grammatical encoding (e.g., Bock & Levelt, 1994), it can be argued that animacy would influence the choice of grammatical function assignment (the functional level), and subsequently it influences the choice of word order (the positional level). However, as Kempen and Harbusch (2004) and Branigan et al. (2008) noted, it seems 'unparsimonious' that such a model can explain the effect of animacy on grammatical function assignment and word order.

Branigan et al. (2008) suggest that in an alternative model, grammatical functions and word order would be determined during a single stage of processing, with entities being assigned a grammatical function and a word order position simultaneously. Conceptually more accessible entities (e.g., animate) seem to be retrieved earlier than conceptually less accessible entities (e.g., inanimate). Thus animate entities would tend to be assigned in both higher grammatical functions and earlier word order positions. This suggests the possibility of a different architecture for grammatical encoding, where both grammatical role and serial order assignments in grammatical encoding would be formulated at one single stage.

Branigan et al. (2008) furthermore suggest that such a view is compatible with an extended model of lexico-syntactic representation proposed by Pickering and Branigan (1998). In chapter 2 (section 2.1.1) I discussed the theory of lexical access in production, developed by Levelt et al. (1999). To recall, Levelt et al. proposed that a conceptual representation for a word is linked to a lemma representation and a word-form representation. The lemma contains an abstract representation which specifies syntactic information (e.g., grammatical gender or class).

Pickering and Branigan furthermore claimed that grammatical information is represented at the lemma stratum and certain words are linked to combinatorial information in lemmas. For example, the lemma for *give* would be linked to a combinatorial node associated with the prepositional object (PO) construction (e.g., *give the book to the boy*) and a combinatorial node associated with the double object (DO) construction (e.g., *give the boy the book*). When people produce one of these constructions, they activate both the lemma and the relevant combinatorial node. Such a model is compatible with the finding that people tend to repeat syntactic structures (syntactic priming; Bock, 1986a; Bock et al., 1992, I will discuss this issue in chapter 4), and that this tendency is stronger when the verb is repeated across sentences (Branigan et al., 2000; Pickering and Branigan, 1998). In Pickering and Branigan's model, this syntactic

priming effect is explained in terms of residual activation of a combinatorial node, and lexical enhancement is explained in terms of strengthening of the link between a combinatorial node and a particular verb lemma.

Branigan et al. (2008) furthermore suggests an extended model that both word order and grammatical function assignment are differentiated at the lemma stratum. Branigan et al. (2008) assume that when people access a verb lemma, they also access the combinatorial nodes of the voice (which is associated with grammatical function assignment) and the constituent structure (which specifies constituent structure such as word order). Such a model is consistent with the view that, from the results of the current studies, Japanese speakers make a one stage choice between SOV-active, SOV-passive, OSV-active and OSV-passive. The question here is, as Bock et al. (1992) showed, whether it is possible to see the syntactic priming effect of grammatical functions and constituent structure. If so, I will be able to confirm that the verb lemma contains the combinatorial nodes of a voice and a constituent structure, and such processing is formulated in one stage. This issue will be returned to in the discussion of chapter 4.

There are several remaining questions regarding the current study. First of all, compared to the current studies, Christianson and Ferreira (2005)'s study produced a different result. Their picture-description task in Odawa included three different types of questions (General question: *what is happening?* vs Agent-question: *what is the boy doing?* vs Patient-question: *what is happening to the girl?*). Their Odawa participants described pictures with passive and inverse forms more frequently after Patient-question questions. However, when they separately analysed sentences with mixed-animacy (animal-agent/human-patient), participants produced fewer passive forms. This led Christianson and Ferreira to propose a weakly incremental model of language production to explain this result (a similar model was proposed by V. Ferreira & Dell, 2000). However, their results were somewhat puzzling – their

participants produced fewer passive forms when the pictures were animal-agent/human-patient. Since the results of the current experiments showed that Japanese is also a relatively free word order but that the order of SOV sentence did not invert even if there was a mixed-animacy order (inanimate-animate order becomes animate-inanimate order), I suggest that the preference for SOV order was so strong that it overcame the effect of conceptual accessibility.

Secondly, it has to be clarified whether the word order of SOV and OSV sentences in Japanese is the same or different semantically. There have been many studies about the processing of different word orders in language comprehension (Yamashita, 1997, Tamaoka et al., 2005). However, there have not been any studies working on the precise nature of the meaning of different word orders in Japanese (e.g., the semantic difference between SOV and OSV), particularly in language production. For instance, it has been suggested that the motivation of producing OSV orders is due to ‘focus’, placing the object first to express the word that a speaker wants to focus (Yamashita, 2002) or ‘givenness’, which is the tendency to mention ‘given’ arguments before ‘new’ arguments (Ferreira & Yoshita, 2003). An experimental study by Yamashita and Chang (2001) showed that while there was a tendency for Japanese speakers to correctly recall sentences involving a shorter phrase as in (50), they tended to place longer phrase earlier (51). This is the opposite result of English (e.g., Hawkins, 1994).

(50) Keezi-ga hannin-o oikaketa.

Detective-Nom suspect-Acc chased

‘The detective chased the suspect’

(51) Keezi-ga se-ga takakute gassiri sita hanninn-o oikaketa

Detective-Nom height tall big-boned suspect-Acc chased

‘The detective chased the suspect who was tall and big-boned’

Thus such a difference may influence the choice of word order. However, other aspects of word order change or the motivation of producing word order remain unclear, particularly in language production.

The final concern is the methodology. A large number of studies discussed in this paper (including the current study) used the sentence recall methodology. As I discussed previously, although recall paradigms can simulate the natural processes of production (as claimed by Potter & Lombardi, 1990; Bock, 1996), it is plausible that this type of task may hide the real differences between recall process and natural process of production. For instance, since this type of task is memory-based, there are some concerns that some lexical items may be temporally more accessible than others and they may be retrieved faster during recall. Or it may also be possible that participants tend to remember the form of certain types of sentences better than others (e.g., passives more than actives). Does this always happen in memory-based tasks? If so, what is the relationship between memory and conceptual accessibility? I leave these as questions for future research.

3.17. Summary

In sum, two sentence recall experiments in Japanese showed a role for conceptual accessibility in determining grammatical function assignment and word order. I interpret these results as evidence that conceptual accessibility influences the production of Japanese, and this suggests highly incremental syntactic processing. I also suggest that these results are consistent with the lemma stratum proposed by Pickering and Branigan (1998) and Branigan et al. (2008), that the combinatorial nodes of the lemma are linked to the grammatical function assignment (voice) and constituent structure (word order).

Chapter 4

Syntactic priming and Animacy

4.0. Introduction

So far, we have seen that two sentence recall Experiments in Japanese showed that animacy can contribute to the production of syntactic structure. In particular, animacy plays a role in the choice of voice (active/passive), with animate entities being assigned grammatically more prominent positions (as subject in this case) than inanimate entities, which are assigned less prominent positions (object). I also showed that animacy influences the choice of word order – animate entities tend to precede inanimate entities regardless of the syntactic structure (active or passive) in the sentence. Furthermore, I discussed that such results support an incremental model of language production, and furthermore they suggest that the representation of functional processing and positional processing could be more flexible than it is suggested under the current models of production (Bock & Levelt, 1994; Garrett, 1980). Thus such results are consistent with the lexico-syntactic representation of the lemma stratum (Pickering and Branigan, 1998), suggesting that the combinatorial nodes of grammatical function and constituent structure may be linking to the verb lemma.

However there are several remaining questions that have to be solved. One of the questions concerns the methodology. The sentence recall tasks that I adopted in the two previous experiments were based on the memory task, and it has been suggested that such memory tasks may not reflect the natural process of language production (Bock, 1996), since it would be possible that some highly activated words could be retrieved from the memory more quickly than less activated ones, as a result the highly activated word may

be placed early in the sentence and it may influence the choice of syntactic structure (recalled more OSVs than SOVs). Or it may also be possible that participants tend to remember the form of certain types of sentences for longer than others (e.g., passives more than actives).

Related to this methodology issue, Bock et al. (1992) used a picture description task to investigate animacy priming and found that there was a tendency to bind particular animacy features to particular grammatical functions. This appeared as a reliable tendency for participants to produce a target description with an inanimate subject after repeating a prime with an inanimate subject than a prime with an animate subjects regardless of whether they produced actives or passives. In other words, animacy only seems to influence the choice of active/passives which is thought to take place at the functional level. This is consistent with findings by Bock & Warren (1985). However, as I have shown in chapter 3, such a hypothesis does not fit with the results of Japanese experiments (Experiment 1 and 2) that I conducted, since animacy influences the choice of both voice and word order in Japanese.

In order to investigate these issues, this chapter will examine how animacy influences syntactic processing in Japanese sentence production using an alternative methodology, called the 'Syntactic priming task'. It also discusses how animacy and syntactic priming can contribute to models of language production (Bock & Levelt, 1994; Garrett, 1980).

This chapter is organized as follows: first of all I will overview the earlier studies about syntactic priming, which mainly used the constructions of prepositional and double objects (PO and DO), and actives and passives in English. Then I will examine similar priming effects with other constructions (complementiser '*that*', finite-infinite complements, different word orders in Dutch). I discuss how such priming effects can be seen using other methodologies (sentence recall, dialogue), other languages, with

bilingual speakers, and in patients with agrammatism. In order to account for such an effect, two different hypotheses - a residual activation account and an implicit learning account - are discussed. I will then focus on animacy and the syntactic priming effect from Bock, Loebell and Morey (1992)'s study and discuss the problems with their account. Finally, I will present three priming Experiments that were conducted in Japanese (Experiments 3 and 4) and English (Experiment 5), and discuss how such priming effects could contribute to models of language production.

4.1. Syntactic priming

4.1.1. Introduction

This section overviews the empirical studies about syntactic priming.

What is special about human language production is the creativity of its speech. However, some types of repetition have been observed during conversations. By repetition, I mean that there are some *lexical* or *syntactic* repetition effects during conversations. Although most of these repetitions are considered to be lexically related, some evidence suggests that *structural* repetition also occurs in natural dialogue (e.g., Schenkein, 1980; Tannen, 1989). For example, Schenkein (1980) observed a repetition of sentences between speakers and listeners (when speakers said '*But can you go to sleep tonight?*' listeners said '*How am I going to sleep tonight?*').

Weiner and Labov (1983) analyzed a corpus containing passive sentences and found that there was an increased amount of passive production after having produced passives; almost 70% of passive sentences were produced after passive sentences appeared previously. Although studies such as Estival (1985)

reanalysed Weiner and Labov's data to investigate such effects in a corpus study, such structural repetition has been a controversial issue, since it is difficult to define what causes such a repetition effect. It is possible that such apparently structural repetition could be due to purely lexical repetition without involving any syntactic processes, or it could be because speakers try to develop their conversations in a very formal way, as a result showing frequent usage of the passive forms.

Therefore, in order to determine if such repeated usage of the same syntactic forms is due to specifically syntactic effects, it is necessary to rule out alternative explanations (such as lexical or phonological influences). Some psycholinguistic research has been carried out in this area, and structural repetition, often called *syntactic priming*, has been demonstrated by many experimental studies. I overview the empirical studies below.

4.2. Syntactic priming – empirical studies

4.2.1 Empirical studies

Levelt and Kelter (1982)

The first experimental study that investigated the syntactic priming effect was by Levelt and Kelter (1982). They ran a series of experiments to investigate the repetition of surface form. They conducted a question-picture paradigm, in which participants were asked a question about the pictures they saw (this study was run in Dutch). For instance, participants saw a picture in which a boy *Paul* was showing his violin to a girl called *Toos*. There were two types of questions that the experimenter asked, one contained prepositions and the other did not.

(52)

a. *Aan Wie laat Paul zijn viool zien?*

(To whom lets Paul his violin see?)

b. *Wie laat Paul zijn viool zien?*

(Whom lets Paul his violin see ?)

According to Levelt and Kelter, there should not be any semantic difference between these two questions. However, it was possible to answer these questions in two ways;

(53)

a. *Aan Toos.*

(To Toos.)

b. *Toos.*

(Toos.)

Levelt and Kelter also ran experiments based on telephone conversations. The experimenters called several shops and asked shopkeepers how long they were open. When they asked the closing time, it was possible to ask them in two ways in Dutch;

(54)

a. *Hoe laat gaat uw winkel dicht?*

(What time does your shop close?)

b. *Om hoe laat gaat uw winkel dicht?*

(At what time does your shop close?)

As in Levelt and Kelter's previous experiment, the only difference was the additional preposition in (54-b), but not in (54-a). As explained before, it was possible to reply to such questions using either the structure '*Om vijf uur (at five o'clock)*' or '*vijf uur (five o'clock)*'.

Levelt and Kelter confirmed that in both experiments their participants preferred to answer the questions with prepositional phrases when the experimenter asked the questions with prepositions. If the question was without prepositions, participants also answered them without prepositions. These results led Levelt and Kelter to conclude that reusing the surface form of a sentence may have two benefits. One is that it might help listeners to follow the conversation better. Another was that it might be possible that speakers could reduce the effort needed to produce words if they reuse the syntactic form, instead of generating the syntactic structure from the beginning. However, an alternative explanation for Levelt and Kelter's findings is that it was also possible that these priming effects might be lexical (repetition of the prepositions '*to*' or '*at*', Pickering & Garrod, 2004).

Bock (1986a)

Strong evidence of syntactic priming in language production comes from experimental studies conducted by Bock and colleagues (Bock, 1986a; Bock, 1989; Bock & Loebell, 1990; Bock, Loebell & Morey, 1992). Their experimental works showed that speakers tended to repeat the syntactic structures that they had previously produced, and this occurred even when the sentences presented in their experiments differed in prosodic, lexical, and conceptual content.

The first reported evidence for syntactic priming came from Bock (1986a). In her paradigm, participants heard or read sentences which could be described with one of several syntactic forms. Then

participants saw pictures which were semantically unrelated, and they were asked to describe them verbally. For instance, they may have heard or read either an active sentence (55-a) or a passive sentence (55-b) as transitives and either a prepositional object sentence (PO, 56-a) or a double object (DO, 56-b) as datives. Then pictures (e.g., *Lightning striking the church*) which were not related to the priming sentences were presented, and participants were asked to describe them verbally. These pictures could be described either as '*Lightning is striking the church*' or as '*The church is being struck by lightning*' in transitives, and '*the man is reading a story to a boy*' or '*the man is reading a by a story*' in datives:

(55). Transitive

- a. Active – *One of the fans punched the referee.*
- b. Passive – *The referee was punched by one of the fans.*

(56) Dative

- a. PO - *A rock star sold some cocaine to an undercover agent.*
- b. DO - *A rock star sold an undercover agent some cocaine.*

Bock found a strong effect of syntactic priming. For instance, participants were more likely to describe target pictures with passive structures after passive primes than after active primes, or with PO structures after PO primes than after DO primes. Following such results, Bock concluded that the syntactic structures that speakers had previously accessed influenced their choice of syntactic form to describe target pictures.

Bock (1989)

Bock (1989) explored this syntactic priming effect with dative verbs. She tested if prime and target

sentences which used different types of preposition would prime as much as sentences which used the same preposition. Using a similar priming paradigm to Bock (1986a), her participants saw PO priming sentences (57-a) and described target pictures expressing the content such as (57-b);

(57)

- a. *The secretary baked a cake for her boss,*
- b. *The doctor giving the injection to the patient.*

Her participants tended to describe target pictures with PO sentences (e.g. ‘*The doctor gave the injection to the patient*’) more often than with DO sentences even when both prepositions were different (*for* and *to*). This showed that the syntactic priming demonstrated here was purely ‘syntactic’, and not due to lexical repetition between the prime and target sentences, and neither was a discourse explanation possible.

Bock and Loebell (1990)

Bock and Loebell (1990) investigated whether the syntactic priming effect occurs in terms of repetition of thematic structure (or event structure). They conducted two syntactic priming experiments; firstly investigating the priming of similar structures such as (58-a) and (58-b);

(58)

- a. *The wealthy widow drove her Mercedes to the church.* <agent, theme, location>
- b. *The girl handed the paintbrush to the man.* <agent, theme, beneficiary>

Sentence (58-b) had a similar sentence structure to (58-a), but the third thematic role differed. (58-a) contained agent, theme and location, while (58-b) contained agent, theme and beneficiary/goal.

They also tested if Locatives would prime Passives, for instance;

(59)

- a. *The foreigner was loitering by the blinking traffic light. (Locative)*
- b. *The boy was stung by the bee. (Passive)*

In both experiments, Bock and Loebell found that sentence (58-a), containing locative prepositions, primed PO descriptions even when the target sentence did not contain locative prepositions (such as sentence (58-b) with beneficiary *to*). Bock and Loebell also found that locative *by*-phrases (such as in sentence (59-a)) also primed sentences with passive descriptions, such as sentence (59-b).

However, they also found that the prosodic similarities between prime and target sentences did not prime; for example, while '*Stella brought a book to Susan*' and '*Stella brought a book to study*' are similar in terms of the subject noun phrase, metrical structure, in phonology and position of closed-class word '*to*', they differ in constituent structure. Bock and Loebell found that a picture depicting '*A girl handing a paintbrush to a boy*' could only be primed by the former example but not the latter. Bock and Loebell also tested the possibility if priming occurs even when two sentences have conceptual dissimilarities, for instance, Bock and Loebell found that '*The 747 was alerted by control tower*' was as effective a passive prime as '*The 747 was landed by the control tower*' even though it has the conceptual dissimilarities between the two sentences. In sum, these results led Bock and Loebell to conclude that syntactic priming was not due to the repetition of thematic roles, and that priming happened even when prime and target

sentences did not share the conceptual similarities.

Bock, Loebell and Morey, 1992

Bock, Loebell and Morey (1992) investigated the effects of animacy and syntactic priming on language production. They also conducted a picture description task, presenting participants with sentences that varied in their active/passive voice and the animacy of the subject and direct object (animate subject-inanimate object '*Five people carried the boat*', inanimate subject-animate object '*The boat was carried by five people*') and asking them to describe target pictures. As other studies showed, Bock et al. (1992) found an overall tendency to repeat the same syntactic structure (active after active, '*The alarm clock woke the boy*', passive after passive, '*The boy is being woken by the alarm clock*'). In addition to this, their participants were more likely to describe target pictures with inanimate subjects such as '*The alarm clock woke the boy*' after they had read sentences with inanimate subjects '*The boat was carried by five people*' than after they had read sentences with animate subject such as '*five people carried the boat*' (I will call this the 'Animacy-binding effect'). These two effects were independent, as the tendency to produce inanimate-animate priming occurred regardless of the syntactic structures (active '*The boat carried five people*' or passive '*The boat was carried by five people*'). They argued that the syntactic priming effect occurs at the constituent assembly level, and that animacy-binding occurs at functional assignment. They claimed that such results support the view that the processes of functional assignment and constituent assembly are separate, and that only grammatical function assignment is affected by animacy variation (as proposed by Bock & Warren (1985)).

In addition to this finding, Bock et al. (1992) indicated that their result contrasted with some linguistic theories, such as Government-Binding theory (Chomsky, 1981). Such theories assume that there is an

underlying structure and that the subject of a passive sentence is the object of the surface structure (this is called 'the mediated mapping account' (Bock et al., 1992). On the other hand, other theories such as the HPSG account (Pollard & Sag, 1987, 1994) deny such an underlying structure and assume that the subject of a passive sentence is always assigned the subject position (this is called 'the direct mapping account' (Bock et al., 1992). Bock et al. found that there was no interaction between the animacy-binding and syntactic priming effects, thus similarities in the animacy features of the underlying arguments of active and passive sentences (e.g., '*Five people carried the boat*' and '*The boat was carried by five people*') had no impact on the priming patterns, though similarities in the animacy features of the surface arguments did (e.g., '*Five people carried the boat*' and '*Five people were carried by the boat*'). Because a direct-mapping hypothesis assumes that the arguments of syntactic functions are the same as the arguments of the surface structures, therefore, Bock et al. (1992) concluded that their result conflicted with the mediated mapping account but supported the direct mapping account, and furthermore suggested that syntactic priming studies can address issues of interest to linguistic theory.

4.2.2 Syntactic priming in other constructions

Syntactic priming has been investigated not only with active/passive or Prepositional Object (PO)/Double Object (DO) structures but also with different constructions. In this section I review several studies regarding this.

Ferreira (2003)

Ferreira (2003) conducted a series of recall-based experiments to investigate the syntactic priming of the complementizer '*that*'. In his experiments, target sentences were presented first (e.g., *The mechanic*

mentioned the antique car could use a tune up.), then prime sentences were presented afterwards (e.g., *The company insured that the farm was converted for two million dollars.*). Then speakers recalled the prime sentences, prompted by the subject and the verb (*company insured*), and finally they were asked to recall the target sentences, prompted similarly (*mechanic mentioned*). In English the complementizer 'that' can be omitted in many sentences. Ferreira found that prime sentences with the complementizer *that* primed more completions with 'that' than those without 'that'. However, Ferreira found that such differences were not because aspects of the sentences were lexically identical, since he did not find a priming effect when the prime sentences used 'that' in the noun complement construction (e.g., *The theory that penguins built the igloos was completely fake.*).

Griffin and Weinstein-Tull (2003)

Griffin and Weinstein-Tull (2003) used Potter and Lombardi's (1998) recall paradigm to investigate syntactic priming of object raising construction when there is also the infinitive alternative, such as *John believed that Mary was nice* versus *John believed Mary to be nice*. Their participants were primed to paraphrase finite compliments as infinitives. Speakers tended to produce these paraphrases most when target sentences were paired with prime sentences that contained object-raising verbs in an active voice with infinitive complements (e.g., *A teacher assistant reported the exam to be too difficult* and *the media prematurely proclaimed the wrong person to be the winner*). They also found that a priming sentence containing an infinitive complement increased the likelihood of a participant producing a finite target sentence containing an infinitive complement, such as infinitive-object control (e.g., *Rover begged his owner to be more generous with food*), and infinitive-subject control (e.g., *Jenny actually intended to be a runner in the race*). In addition, speakers produced more infinitive complements when priming sentences had direct objects which were not the patient of the main verb (e.g., *The programmer hypothesised the*

problem to be in his search algorithm). The only difference between priming sentences was the conceptual role, thus Griffin and Weinstein-Tull concluded that such conceptual roles can influence syntactic structures.

Chang, Bock and Goldberg (2003)

Chang, Bock and Goldberg (2003) examined if thematic roles influence the priming of the order of noun phrase in sentences. They tested two types of prime sentences, Theme-Location (e.g., *The maid rubbed polish onto the table*) and Location-Theme (e.g., *The maid rubbed the table with polish*) with target sentences, either Theme-Location (e.g., *The farmer heaped straw onto the wagon*) or Location-Theme (e.g., *The farmer heaped the wagon with straw*). Theme-Location placed the Theme in the object position and the Location in a prepositional phrase with a directional preposition. Location-Theme placed the Location in the object position and the Theme in a prepositional phrase with the preposition *with*. Chang et al. (2003) used Potter and Lombardi's (1990) sentence repetition paradigm to see if thematic role order primes in sentence production. Their participants were significantly more likely to produce Location-Theme sentences after Location-Theme primes (52%) than after Theme-Location primes (47%), more Theme-Location sentences after Theme-Location primes (54%) than Location-Theme primes (49%). They also found the same effect with prepositional datives and double object primes, when both were benefactive (*An artist drew a sketch for the police captain: An artist drew the police captain a sketch*) or transfer (*An artist showed a sketch to the police captain, An artist showed the police captain a sketch*). Since in both experiments thematic roles were sensitive to the priming effect, Chang et al. (2003) concluded that their results suggest that thematic roles are an important part of functional processing in language production.

Hartsuiker, Kolk and Huiskamp (1999), Hartsuiker and Westenberg (2000)

Hartsuiker, Kolk and Huiskamp (1999) conducted picture description tasks to examine so-called 'word order priming' in Dutch. They compared the Dutch sentences;

(60)

- a. *On the table is a ball.*
- b. *A ball is on the table.*

They claimed that the positions of the two preposition phrases were different, but semantically the sentences remained the same. They found that the participants' target descriptions were influenced by the prime sentences.

Hartsuiker and Westenberg (2000) adopted a different methodology, called a sentence completion task. They examined Dutch auxiliary verbs and past participles to investigate word order priming for both written and spoken language production. The word orders in the Dutch sentences (61-a) and (61-b) were different, but the sentences expressed the same meaning;

(61)

- a. *De man belde de politie omdat zijn portemonnee was gestolen*
The man called the police, because his wallet was stolen.
- b. *De man belde de politie omdat zijn portemonnee gestolen was*
The man called the police, because his wallet stolen was.

As in Hartsuiker et al. (1999), their participants showed a word order priming effect, in that their target completions were influenced by the word order of the prime sentences. Hartsuiker et al. and Hartsuiker and Westenberg argued that the two types of sentences that they tested share the same functional and hierarchical relations, but vary in terms of word order. In this sense, it seems that the final word order of a sentence is not constrained by either functional relations (e.g., subject, object) or hierarchical relations (e.g., S is the node of an NP and VP). Therefore, they suggested that such a priming effect could not be due to the output of the conceptual processing or functional processing levels.

Thus, Hartsuiker and his colleagues argued that word order priming is evidence of 'a linearisation process', which is responsible for the processing of word order. Hartsuiker and his colleagues suggested a multiple-stage account of the formulation of constituent structure. In such an account, positional processing would consist of a dominance only level and a linearization level as well. They argued that the first stage (a dominance only level) specifies the hierarchical relations of constituent structure, but it does not specify linear word order. The linearisation process would then organise representations into a specific word order. Therefore, Hartsuiker et al. (1999) concluded that word order priming occurs at the level of the linearisation process.

In addition to this, they also claimed that such a process would agree with an incremental account of language production: as soon as a word was available it would be retrieved and placed in an early position in the sentence, resulting in fluent speech processing. Hartsuiker and Westenberg's results also showed a similar effect in both written and spoken experiments. This led them to hypothesize that grammatical encoding in both written and spoken language involved similar processes.

Pickering, Branigan and McLean (2002)

Pickering, Branigan and McLean (2002) argued that Hartsuiker and his colleagues' account could be interpreted as a single-stage account. To show this, they conducted a series of written sentence completion experiments and compared PO, DO and 'shifted' prime sentences:

(62)

- a. *The racing driver showed the extremely dirty and badly torn overall to the mechanic.* (PO)
- b. *The racing driver showed the mechanic the extremely dirty and badly torn overall.* (DO)
- c. *The racing driver showed to the mechanic the extremely dirty and badly torn overall.* (shifted)

Pickering et al. (2002) found that 'shifted' primes did not prime PO completions of target sentences, relative to an intransitive baseline prime. They argued that such results supported a single-stage account, suggesting that all three structures are represented at a single level. Pickering et al. (2002) argued that such results were not consistent with a multiple-stage account, because such an account represents structures such as POs and shifted primes in the same way at the first stage. Since shifted responses were very rare responses, speakers were likely to produce PO responses for the target descriptions. Pickering et al. (2002) did not find more PO responses following shifted primes than following intransitives. Therefore, they concluded that the formation of constituent structure takes place in a single stage.

In sum, the empirical studies using experimental tasks by Bock and her colleagues showed that the syntactic priming effect is robust and these studies rule out other possible explanations such as lexical repetition, or prosodic similarities. The syntactic priming effect was observed with not only PO-DO descriptions in English, but also with the complementiser '*that*', infinite complements, and different word

orders. Two Dutch studies by Hartsuiker and his colleagues furthermore support a multiple-stage account of constituent assembly (dominance-only-level and a linearisation level) and suggest that the process of 'linearisation' is responsible for the variation of word order at the positional level. However Pickering et al.'s (2002) results with PO/DO/Shifted constructions showed that the processing of constituent assembly can be formulated at single stage.

4.2.3. Syntactic priming in different methodologies

In the previous section, we saw evidence of syntactic priming not only between PO and DO constructions, but also with other constructions. However, many studies which were reviewed previously adopted a similar methodology, a picture-description task (except Hartsuiker & Westenberg, 2000 and Pickering et al., 2002). In this section I will review other studies which used different methodologies to observe syntactic priming.

Potter and Lombardi (1998)

First of all, Potter and Lombardi (1998) used a sentence recall task to show a syntactic priming effect. As I discussed in chapter 3, Potter and Lombardi (1990) and Lombardi and Potter (1992) used the sentence recall task to see the repetition of particular syntactic structures. Both Potter and Lombardi's and Lombardi and Potter's results suggest that when speakers recalled the sentence, they used recently activated syntactic structures to re-generate it from the verb and it suggests that the original surface structure may not be represented in the short-term memory.

Potter and Lombardi (1998) further claimed that syntactic priming could contribute to verbatim recall.

With the same sentence recall task, when the structure of prime sentences was mismatched to a target with alternative structures, their participants recalled the target sentence with the prime structure. In subsequent experiments, they presented sentences in which the target clause was a dative and the other was the prime (e.g., *The waitress handed a customer two glasses and then sent the manager her resignation.*). Potter and Lombardi manipulated which of the clauses was the prime and which was the target. In both cases where the prime sentence had been read or recalled, or only read but not recalled, their participants showed a priming effect. They also argued that this account is consistent with the relatively rapid loss of verbatim memory for a sentence, as the processes involved are subject to rapid decay.

Taken together, Potter and Lombardi's (1990, 1998) and Lombardi and Potter's (1992) studies suggested that three distinct mechanisms are involved in verbatim memory. The first one represents the meaning of the concept, which re-generates the sentence using normal production mechanisms. The second is the activation of the lexical items of the perceived sentence. Since such lexical items were already activated, speakers were likely to reuse these items. The third is the syntactic priming effect, when speakers tend to reuse the syntactic structure of a sentence they have just recalled. They also argued that this account is consistent with the relatively rapid loss of verbatim memory for a sentence, as the processes involved are subject to rapid decay.

Fox Tree and Meijer (1999)

Fox Tree and Meijer (1999) also ran a similar recall task, where participants read and memorised a sentence. They read a prime sentence and after the distraction task (some words appeared and participants were asked if such words were included in the prime sentence), they were asked to recall the original target sentence. When prime sentences with DO forms '*The father promised to lend his dishonest son the family*

car' were presented, their participants tended to produce the target sentences with DO forms '*While the poet traveled in France, she wrote her family many letters*' even when the original forms were POs. Fox Tree and Meijer furthermore found such priming effects even when the prime and the target sentences did not match in terms of complexity. For instance, a DO target sentence '*The representative of the western nation offered the country an agreement*' was paired with three prime sentences;

(63)

- a. NP-DO complex: *The nurse read the soldier who was wounded the most recent letter.*
- b. NP-PP complex: *The nurse read the most recent letter to the soldier who was wounded.*
- c. NP-PP simple: *The nurse read the most recent letter to the wounded soldier.*

Fox and Meijer found that both simple and complex PO constructions (63-b and c) were more likely to cause a switch in recall compared to DO constructions. Thus, they claimed that simple and complex nouns phrases are constructed using the same syntactic rules. A PO prime sentence caused more PO structures than DOs, regardless of the complexity of the noun phrases of the primes and the targets. Thus, Fox and Meijer claimed that major constituents were constructed first, then internal structures were built by an additional routine and concluded that the locus of the syntactic priming effect was the verb phrase.

Smith and Wheeldon (2001), and Wheeldon and Smith (2003)

Smith and Wheeldon (2001) used an online experiment to test whether the speed of certain syntactic processing is reduced by previous sentences that have been processed. Smith and Wheeldon tested two types of sentences in moving object descriptions, complex-simple (64-a) and simple-complex (64-b);

(64)

a. *The dog and the house move above the spoon.*

b. *The dog moves above the house and the spoon.*

According to Smith and Wheeldon, complexity relates to the use of two nouns, thus example (64-a) is called complex-simple because the subject NP contained two nouns and the object NP contained one noun, but example (64-b) is called simple-complex because the subject NP contained one noun and the object NP contained two nouns.

Using these structures, Smith and Wheeldon asked participants to describe moving objects on a PC screen, producing co-ordinate noun phrases for both the prime and target sentences. The movement of the objects which participants had to describe was manipulated to control the syntactic structure of their descriptions. Thus, when participants had to make a target description (65-a), this could be paired with either a syntactically related description (65-b), or a syntactically unrelated prime (65-c).

(65)

a. *The spoon and the car move up.*

b. *The eye and the fish move apart.*

c. *The eye moves up and the fish moves down.*

Smith and Wheeldon measured the speech onset time and found that when a target sentence was preceded by a syntactically related prime sentence like (65-b), it was about 50 milliseconds shorter than when a target sentence was preceded by a syntactically unrelated prime sentence (65-c). They concluded that the priming effect was only short-lived to the first phrase but did not last until the later one.

Wheeldon and Smith (2003) also examined the syntactic priming effect in sentence production latencies, but they examined it with either no intervening trial, or one or three intervening trials (syntactically unrelated sentences) between prime and target sentences. They found the strongest priming effect when there was no intervening trial, but such an effect disappeared with one or three intervening trials. Thus Smith and Wheeldon (2001) and Wheeldon and Smith (2003) concluded that the syntactic priming effect is short-lived. However, some researchers found that syntactic priming effect is long-lasting (e.g., Bock & Griffin, 2000), thus the longevity of priming effect is not very clear (I will return to this issue in 4.2.6.).

Branigan, Pickering and Cleland (2000a)

Evidence of the syntactic priming effect mostly comes from so called monologue studies. However, Branigan, Pickering and Cleland (2000a) investigated the syntactic priming effect in *dialogue* using a confederate priming task. In their task, pairs of speakers took turns to describe pictures and match them by finding the appropriate picture in an array. One of the speakers was a confederate of the experimenter, and was asked to produce either a PO or DO description of each picture. Branigan et al. (2000a) found that when their participants described the pictures, they were likely to be influenced by the form of the preceding prime trial. Such results suggested that there was a strong tendency for participants to reuse the same syntactic structure that they had previously uttered. They ruled out the possibilities of lexical accessibility and meaning-based coordination as in the previous dialogue studies of repetition (e.g. Garrod & Anderson, 1987), since their prime and target pictures on cards did not use the same entities. Branigan et al. claimed that such a result was evidence of a ‘syntactic coordination effect’, and suggested that the representations underlying syntactic structure were shared between comprehension and production. Such a view is compatible with the model proposed by Levelt et al. (1999).

Taken together, these studies in sentence recall tasks and dialogue tasks have shown that syntactic priming occurs with different experimental methodologies.

4.2.4. Syntactic priming in other languages

Syntactic priming has been found not only in English, but also in different languages. We have seen in the previous section that the syntactic priming effect has been observed in Dutch (Hartsuiker, Kolk & Huiskamp, 1999; Hartsuiker & Westenberg, 2000). More studies in Dutch (Hartsuiker & Kolk, 1998a) and German (Scheepers, 2003) also showed the syntactic priming effect. Additionally, studies with bilingual speakers also showed priming, with such effects in Dutch-English, Spanish-English and German-English speakers. I review these studies below.

4.2.4.1. Syntactic priming in other languages – monolingual studies

Hartsuiker and Kolk (1998a)

Hartsuiker and Kolk (1998a) adopted Bock's (1986a) picture description task and ran a series of experiments to investigate the syntactic priming effect in Dutch. Dutch allows a more flexible word order than English, thus their experiment 1 and 2 tested DOs, medial datives (these are roughly equivalent to shifted POs in English, as in '*the woman gives to the man the paintbrush*') and PO sentences (in experiment 3 medial datives were not presented). In addition to measuring the proportion of target responses, Hartsuiker and Kolk also measured baseline data and the baseline conditions were intransitive primes and constituted the first trials in the sentence. By examining the frequencies of the different structures before the actual experimental session (the primed trial), they were able to assess the relationship between (relative)

frequency and the syntactic priming effect. Their analysis revealed that, although they did not find the priming effect of active and passive transitives, the combined proportion of PO, DO and the medial datives in two experiment was higher during the experiment than at the beginning of trials. Although medial datives were not presented in experiment 3, the effect was similar as in experiment 1 and 2. With these results, Hartsuiker and Kolk concluded that frequency did not influence the priming effect.

Scheepers (2003)

Scheepers (2003) conducted a series of sentence completion tasks to see the priming effect of relative clause (RC) attachment in German. Many studies have observed that the preference of RC attachment varies depending on the language (e.g., Cuetos & Mitchell, 1988). For instance, '*Don mentioned the servant of the actress who was on the balcony*' has two possible attachments; *servant* or *actress*. Many studies have revealed that the preference of such attachments differs between languages (e.g., high-NP attachment preference in Spanish, low-NP attachment preference in English (Mitchell & Cuetos, 1991)). Scheepers conducted sentence completion tasks in German and found that there was a preference for high-NP attachment (e.g., *servant*) than low-NP attachment (e.g., *actress*) in comprehension of the target sentences when German participants had previously comprehended high-NP attachments. Such results led Scheepers to conclude that not only the local aspects of syntactic structures (subcategorization frames or individual phrase structure rules) were primed but global aspects (hierarchical attachment configurations) were also primed.

4.2.4.2. Syntactic priming in bilingual speakers

As well as monolingual studies, there have also been several studies investigating the effect of

syntactic priming across languages.

Loebell and Bock (2003)

Loebell and Bock (2003) conducted a picture description task to see whether speakers' first or second language would influence the description of pictures in the other language. Loebell and Bock used German or English dative (PO or DO) and transitive structures (active or passive). They found a priming effect in both PO and DO sentences, and active sentences. Although they did not find any priming effects for passive structures, they explained that it may be due to the difference of passive structures between English and German. For instance, German passives required the verb at the end of the sentence (66-a), but this was not the case in English (66-b).

(66)

a. *Die Boeden werden taglich von dem Hausmeister gereinigt.* (German)

(Literally: The floors are daily by the janitor cleaned).

'*The floors are cleaned daily by the janitor.*' (English translation)

b. *The janitor cleans the floors daily.*

This may furthermore suggest that priming might require word order correspondence between prime and target.

Meijer and Fox Tree (2003)

Meijer and Fox Tree (2003) ran a series of sentence recall experiments with Spanish-English

bilinguals. They used the same method as in Fox Tree and Meijer (1999)'s recall experiment. Participants read target and prime sentences, then after the judgment task they were asked to recall the first sentence they had read. With the NP-NP construction sentences in English (*The waiter brought the customers a tray of drinks*), their participants were more likely to recall NP-PP construction sentences (*The waiter brought a tray of drinks to the customers*) after NP-PP constructions than NP-NP constructions in Spanish. This happened whether targets and primes showed or did not show thematic similarities (locative or prepositional phrase, *The witch cooked her magical soup in the pan when she laughed*), or even when the prime sentence was in English and the target sentence was in Spanish.

Hartsuiker, Pickering and Veltkamp (2004)

Hartsuiker, Pickering and Veltkamp (2004) used a confederate-script task in Spanish (first language)-English (second language) bilinguals. Their experiment was similar to Branigan et al.'s (2000a) confederate-script description task; there were several cards that speakers had to describe. So-called 'naïve' participants described one card in English and a confederate described the other card in Spanish. There were 4 types of prime sentences, active, passive, OVS and intransitive:

(67)

- a. *The taxi chases the truck. (active)*
- b. *The truck is chased by the taxi. (passive)*
- c. *The truck (chasee) it chases a taxi (chaser). (OVS)*
- d. *The taxi accelerates. (intransitive)*

When a confederate used passive structures to describe the cards in Spanish, the naïve participants also

tended to describe cards with passive forms in English. Hartsuiker et al. confirmed that the syntactic priming effect occurs between two languages and suggested furthermore that the syntax of the two languages in bilinguals could be shared.

Desmet and Declercq (2006)

Desmet and Declercq (2006) conducted a priming experiment looking at relative clause attachment in Dutch (based on Scheepers's (2003) German study). Their bilingual study showed that Dutch speakers with high-proficiency English tended to produce high relative clause attachments in English more often when they had previously produced high attachments in Dutch rather than low attachments. Such a result replicated Scheepers's finding about the syntactic priming effect of relative clause attachments. They replicated the results in an experiment in Dutch and English, and this time it was confirmed crosslinguistically.

In sum, priming studies with other languages and bilingual speakers suggest that the syntactic priming effect is not limited to one particular language but occurs cross-linguistically. Such findings furthermore can inform us about the representation of syntactic information within different languages; it is plausible that syntactic information between different languages could be shared.

4.2.5. Syntactic priming in agrammatism

The evidence for the syntactic priming effect comes from not only healthy speakers but also agrammatic patients. Saffran and Martin (1997) tested agrammatic patients in a picture description task similar to Bock's task (1986a). Their patients produced more passives after passive prime sentences, and

although dative priming effects did not seem to occur during the priming task, the production of datives increased in post-test productions compared to pre-test (in an elicitation task).

Hartsuiker and Kolk (1998b) also examined the syntactic priming effect in agrammatic patients and found that their patients showed a stronger priming effect than healthy speakers. In particular they observed that their patients produced passive sentences more, even though agrammatic patients typically have some problems producing passive sentences (e.g., see Grodzinsky, 2000 for more details). Such findings may suggest that syntactic priming helps agrammatic patients to reproduce the previous structures, but still, they may not produce syntactically correct forms every time they produce sentences.

In sum, Hartsuiker and his colleagues showed that the syntactic priming effect occurs in the speech of aphasic patients. This would potentially prove that syntactic priming can help speakers to construct syntactic forms during sentence formulation.

4.2.6. Residual activation or an implicit learning account?

So far, we have seen evidence of syntactic priming from various studies. There has been a debate about how such a priming effect could be accounted for. There are two different views, one is called a lexicalist, residual activation account (Pickering & Branigan, 1998), and another view is an implicit-learning account (Bock & Griffin, 2000; Chang, Dell & Bock., 2000; 2006; Ferreira & Bock, 2006). In both cases there are some empirical studies supporting these hypotheses. I will review these accounts.

Pickering and Branigan (1998)

While Bock and her colleagues' studies used spoken completion tasks, Pickering and Branigan (1998) explored the syntactic priming effect with written sentence completion tasks. First of all, their participants saw sentences such as,

(68)

- a. *The racing driver showed the torn overall...*
- b. *The racing driver showed the helpful mechanic...*
- c. *The racing driver gave the torn overall...*
- d. *The racing driver gave the helpful mechanic...*

(69)

The patient showed...

Sentences such as (68-a) and (68-c) were more likely to be followed by PO structures '*...to the mechanic*', while sentences such as (68-b) and (68-d) were likely to be followed by DO structures '*...the overall*'. Target fragments, such as (69), were then shown to the participants. The following target fragments could be completed with POs (*...his leg to the doctor*), DOs (*...the doctor his leg*), or others (*...off a lot*). Pickering and Branigan found that their participants were more likely to use the same syntactic structure that they completed the prime sentences with (PO after PO, DO after DO). They found that such priming effect was much stronger when both prime and target verbs remained the same. They also found that changing the form of the verbs (such as tense '*give – gave*', number '*gives – give*', or another aspect of the verb '*was giving – gave*') did not affect the priming effect. They claimed that such results suggested that

grammatical information was represented at the lemma stratum. According to Pickering and Branigan, such a priming effect would be affected by the representation of syntactic information at the lemma level. In addition to this, they claimed that certain words (in their example, the verb 'give') were linked to combinatorial information in lemmas. For example, if we assumed that words were associated with the representation of syntactic forms, then we would expect that a verb should be linked to syntactic rules of how it should be combined with other words in order to construct a sentence. Once speakers have produced a sentence with one particular form (e.g., PO or DO), the residual activation of the combinatorial node might result in re-use of the previously activated structure in a subsequent sentence. Since the effect of syntactic priming was stronger when the prime and target trials shared the same verb, Pickering and Branigan argued that this effect was due to activation of the links between the nodes and the nodes themselves. This assumes that the residual activation of the link between the verb node and the combinatorial node would result in stronger priming than when the target contained the verb which could take PO or DO structures. In addition, combinatorial information seemed to relate to unspecified grammatical forms of the verb, since they did not find any differences of priming effects when the tense, aspect or number of the verbs differed between prime conditions.

Contrasting with this view, Chang, Dell, Bock and Griffin (2000) and Chang, Dell and Bock (2006) propose the implicit-learning account, which predicts that syntactic priming is a form of implicit learning, and is influenced by error-driven learning (e.g., the backpropagation of errors). So, when there are several syntactic variations of the same message, the syntactic processor would be altered so that the corresponding syntactic procedures were more readily processed. Since their account concerns abstract syntactic processes, which take place independently of the mental lexicon, the model proposed by Chang et al. hypothesises that the verbs' lexical overlap between prime and target sentences should not affect the priming effect. Thus, unlike Pickering and Branigan's account, Chang et al.'s account does not predict a

lexical boost.

The models proposed by Pickering and Branigan (1998), and Chang and his colleagues (Chang et al., 2000; Chang et al., 2006) presented in the literature have differing views on the longevity of the syntactic priming effect. The residual activation account predicts the rapid decay of syntactic priming effects. In fact, there are some empirical studies which support the rapid decay effect of syntactic priming (Levelt & Kelter, 1982; Branigan, Pickering & Cleland, 1999).

As we have seen previously, Levelt and Kelter (1982)'s telephone conversation task showed that their participants produced more prepositions (*At five o'clock*) when the question also contained that preposition compared to when it did not (*(At) what time does your shop close?*). However, the syntactic priming effect disappeared when there was an intervening sentence (e.g., *since I have to come especially into town therefore, you see*). Branigan et al. (1999) used Pickering and Branigan (1998)'s written sentence completion task and found that the magnitude of the syntactic priming effect was rapidly reduced even if there was only one unrelated sentence between the prime and target sentences. They further found that priming effect disappeared if there were four unrelated sentences between the prime and target sentences. Although Branigan, Pickering, Stewart and McLean (2000b) used a spoken sentence completion task and found long-lived priming effect, Branigan et al. (2000b) suggested that differences between these modalities (e.g., in processing time or effort) may affect the patten of priming, so that priming is long-lived in spoken production but short-lived in written production.

Branigan et al. (2000a) argued that their results from a confederate-scripted task were inconsistent with an account of priming which was based on the residual activation of procedures associated with producing syntactic forms (e.g. Bock & Loebell, 1990). As the procedures involved in comprehension and

production are not the same, this account cannot explain the occurrence of syntactic priming from comprehension to production. Instead, the results supported the model proposed by Pickering and Branigan (1998), where priming arose as a result of the residual activation of syntactic information at the lemma level.

Furthermore, as we discussed in the previous section, Smith and Wheeldon (2001) measured the speech onset time of moving object descriptions and found that when a target sentence was preceded by a syntactically related prime sentence (e.g., complex-simple; *The dog and the house move above the spoon.*), it was about 50 milliseconds shorter than when a target sentence was preceded by a syntactically unrelated prime sentence (e.g., simple-complex; *The dog moves above the house and the spoon.*). They concluded that the priming effect was only short-lived to the first phrase but did not last until the later one. Wheeldon and Smith (2003) also found the strongest priming effect when there was no intervening trial between prime and target sentences, but such an effect varied with one or three intervening trials. Thus Smith and Wheeldon (2001) and Wheeldon and Smith (2003) concluded that the syntactic priming effect is short-lived. In short, there is considerable evidence from several experimental studies that the effect of syntactic priming decays rapidly.

Contrary to this view, the implicit-learning account predicts a long-lived priming effect. It is assumed that changes of mapping a message (e.g., *The man giving a flower to a girl*) to one particular structure (e.g., *The man gave a flower to a girl*) are thought to be permanent and such changes remain the same until they encounter the similar message with an alternative structure (e.g., *The woman handed a teacher a tape recorder*). Thus, the implicit-learning theory predicts that syntactic priming will be long-lived even after the intervening time or the number of unrelated sentences separating a prime and a target sentence (Bock & Griffin, 2000).

Evidence for a long-term priming effect comes from several experimental studies. As we saw in the previous section, Hartsuiker and Kolk (1998a) demonstrated that their participants produced a smaller proportion of target responses in the trials than in the actual experimental session. In addition, the effect of syntactic priming did not change with the time-interval between the prime and trial (0 vs. 1 sec.). They argued that such results demonstrated long-term priming, suggesting that every time the participant produced the particular structure, there was an increasing chance of using the same structure in the long term.

Bock and Griffin (2000) adopted Bock's (1986a) picture description task and tested the effect of syntactic priming with various time-delays; either the prime sentence (either PO: *The rock star sold some cocaine to an undercover agent* or DO: *The rock star sold an undercover agent some cocaine.*) was followed by a target picture (e.g., a girl handing a paintbrush to a man) immediately, or there were 0, 1, 4, or 10 intervening trials between the prime and target trials. They found that participants were more likely to produce a PO sentence (*The girl handed a paintbrush to the man*) after a PO prime than after a DO prime, and more likely to produce a DO sentence (*The girl handed the man a paintbrush*) after a DO prime than after a PO prime. In addition to this, they also found that intervening trials did not affect the magnitude of the priming effect, and the priming effect lasted for as many as ten intervening sentences. Such a finding was in contrast with the finding by Branigan et al. (1999) (also Levelt & Kelter, 1982), and their results led Bock and Griffin to conclude that syntactic priming is due to an implicit learning element, suggesting a long-lasting priming effect. They claimed that speakers were not likely to memorise the syntactic form of the sentence itself, but that the priming effect affected the speaker's choice of syntax.

Further discussion of such accounts would be beyond the scope of this thesis. However, in short, the current evidence about syntactic priming is compatible with two different accounts, the residual activation

account, and the implicit-learning account.

4.2.7. Summary

We have seen a series of studies demonstrating the effect of syntactic priming: a tendency for speakers to re-use the syntactic structures that they have processed previously. Such a priming effect occurs not only with some particular structures (PO/DO, active-passive), but also with the complementiser ‘that’, finite-infinite complements, and different word orders in Dutch. The syntactic priming effect also occurs in sentence recall tasks and dialogue, and it can be seen with other languages (German, Dutch), between two languages (Dutch-English, Spanish-English), and with agrammatic patients. I also discussed two possible explanations for the mechanism of the syntactic priming effect: the residual activation and the implicit-learning theories.

4.3. Animacy and syntactic priming in language production

4.3.1. Background of the current studies

So far, it has been shown by many studies that the syntactic priming effect is robust. The questions I address in this thesis are: (1) at what stage of language production syntactic priming originates, and (2) the precise nature of the functional level and the positional level.

The first question is the stage at which the syntactic priming effect originates during language production. As we have seen in the previous section, although many studies have found an effect of syntactic priming, it is still not clear at what stage of language production syntactic priming originally occurs. Originally, Bock claimed that the syntactic priming effect occurs either during the functional level

when lemmas are retrieved and assigned grammatical roles (e.g., subject, object), or at the positional level, which includes the process of constituent assembly (Bock, 1986a; Bock & Loebell, 1990; Bock, Loebell & Morey, 1992). As a reminder, the previous section saw that Bock and Loebell (1990) showed that two dative sentences containing the location 'to' (e.g., *The wealthy widow drove her Mercedes to the church*) primed dative sentences containing the beneficiary 'to' (*The girl handed the paintbrush to the man*). Hence they claimed that this priming effect did not occur at the stage of conceptual planning. They also found that locative 'by' (e.g., *The construction worker was digging by the bulldozer*) primed passive 'by' (e.g., *The construction worker was hit by the bulldozer*). Since locative and passive sentences shared the same constituent structures but were different in terms of thematic and grammatical roles, such results could not be explained by the claim that syntactic priming occurs during functional processing. Therefore, Bock and Loebell suggested that the origin of such a priming effect was at the constituent assembly component of the positional level.

However, Bock, Loebell and Morey (1992) later discovered an overall tendency for speakers to repeat the same syntactic structure (active after active, '*The alarm clock woke the boy*', passive after passive, '*The boy is being woken by the alarm clock*'), and that they were more likely to describe pictures with an inanimate subject rather than an animate subject after they had read a sentence with an inanimate subject (I will call this the Animacy-binding effect). The two effects were independent, thus the tendency towards inanimate-animate priming occurs regardless of the syntactic structures (active or passive). They argued that these effects were not due to thematic role priming, but were interpreted as the priming of animacy binding at the functional assignment level.

However, there are some conflicts about how the animacy-binding effect should be interpreted, in other words, the origin of the animacy-binding effect under the current models of language production (e.g.,

Bock & Levelt, 1994; Levelt et al., 1999). First of all, it has been suggested that Bock et al.'s result of syntactic priming could be interpreted in another way. It could be possible that such a priming effect was due to the word order preference, that is, it could be a simple repetition of particular animacy assignments to particular word order positions (pre-verbal vs. post-verbal NP). This would reflect a language-specific effect. Since Bock et al.'s study has not been replicated at all, this finding is limited to English. As we have seen in my previous experiments in chapter 3, word order in English is rigid and it is difficult to separate the functional level and the positional level, in order to test such priming effects. In this sense, it is difficult to identify at what stage syntactic priming occurs in both the functional and the positional levels.

In terms of the animacy binding effect, Bock et al. (1992) found that there was a tendency to bind particular animacy features to particular grammatical functions. This appeared as a reliable tendency for participants to produce a target description with an inanimate subjects after repeating a prime with an inanimate subject than a prime with an animate subjects. However, it is also possible that Bock et al.'s finding can be interpreted as a tendency to place particular animacy features to the particular word order positions (early in the sentence or late in the sentence).

Secondly, some researchers have also claimed an alternative interpretation of Bock et al.'s results. Hare and Goldberg (1999) ran a similar experimental task to that of Bock and Loebell (1990), in which participants described pictures after they had produced (70-a) a PO (a dative), (70-b) a DO (ditransitive), or (70-c) a 'provide with' sentence,

(70)

- a. *His editor promised the hot story to Bob.*
- b. *His editor offered Bob the hot story.*
- c. *His editor credited Bob with the hot story.*

The 'provide with' sentence (70-c) matched the PO sentence (70-a) but not the DO sentence (70-b) in terms of syntactic structure. In another sense, sentence (70-c) matched the DO (70-b) but not the PO (70-a) in terms of conceptual structure, because the recipient '*Bob*' was placed after the verb in (70-b) and (70-c), but in (70-a) the theme '*the hot story*' was placed after the verb. Hare and Goldberg's results suggested that their participants produced a similar proportion of DO sentences after DOs and 'provide with' sentences, and these proportions were higher than the proportion after PO sentences. Hare and Goldberg concluded that this difference in proportions was due to conceptual differences, and that this indicated conceptual priming occurring at the conceptual level.

Hartsuiker et al. (1999) interpreted the findings of Bock et al. (1992) as follows; they suggested that when the lemmas of a subject phrase (e.g., *boat*) and a object phrase (e.g., *five people*) are assigned in order to describe the picture '*A boat carrying five people*', it is decided at the functional level that the picture description will be a passive sentence. If we assume that the model of production is feed-forward, it is not possible to decide this order at the positional level. Thus they argued that this syntactic priming effect must occur at the functional level. Furthermore, they claimed that since animacy is a conceptual role, rather than a grammatical one, the animacy binding effect must be located at the conceptual level. Chang, Dell, Bock and Griffin (2000) also claimed that such an animacy binding effect occurs between the conceptual and functional levels. In fact, a later study by Hartsuiker and Westenberg (2000) showed priming of word orders of auxiliary verb and past participle in Dutch, and they claimed that such a priming effect occurred at the positional level.

Heydel and Murray (2000) claimed that the syntactic priming effect is related to conceptual features. They investigated cross-linguistic priming effects in German and English using a translation task. German

word order does not usually match the order of English in both active (71-a) and passive (71-b).

(71)

a. *Ein PR-Mann berät den Manager.*

A PR-man advises the manger.

b. *Der Manager wird von einem PR-Mann Beraten.*

(literally: the manager is by a PR-man advise)

The manager is advised by a PR-man.

c. *Den Manager berät ein PR-Mann.*

(literally: The manager (obj), A PR-Man advises)

A PR-Man advises the manager..

Despite of such differences, they found that German topicalizations as in (71-c), which are similar to dislocated actives in Spanish (Prat-Sala & Branigan, 2000), primed English passives (e.g., *The manager is advised by a PR-man*). However, Heydel and Murray claimed that this priming effect was not due to the syntactic one, since German topicalizations (71-c) behaved like passives primed English passives. German topicalizations and English passives have the same conceptual form but the different syntactic form, thus Heydel and Murray interpreted this effect as evidence of a conceptual priming effect. However, since a normal conversation usually does not involve translation between two languages, some suggest that such a translation effect may have obscured the data in this study (Cleland, 2003). Thus it is still uncertain how such an animacy-binding effect can be interpreted under the current models of language production (Bock & Levelt, 1994; Garrett, 1980).

Therefore, the aim of the three experiments presented in this chapter is to examine the effects of animacy and syntax on language production by using a syntactic priming paradigm. By doing so, I hope to be able to identify at what stages priming effects such as word order priming (SOV/OSV), and voice priming (active/passive) occur. In order to test these, I carried out three picture description experiments: two experiments in Japanese aimed to investigate whether an animacy-binding effect occurs in Japanese, and furthermore to identify at what stage word order priming and voice priming occurs. Another experiment in English was also carried out in order to determine whether the priming effects that I presented in Japanese were due to differences between Japanese and English.

4.4. Experiment in Japanese SOV-OSV priming

First of all, as we have seen in chapter 3, it is possible to test the separate stages of the functional and the positional levels in Japanese, since Japanese is a relatively free word order language and NP-objects can precede NP-subjects. Thus, for instance, compared to canonical order SOV (72-a) where an NP with *Ga* as a Japanese nominative case marker precedes an NP with *O* as a Japanese accusative case marker, an NP with *O* precedes an NP with *Ga* and it creates OSV order (72-b):

(72)

a ... S(ani) O(inani)V

5 人の人がボートを運んだ。

Gonin no hito-ga booto-o hakon-da.

Five people-nom boat-acc carried-past

'Five people carried the boat.'

b ... O(inani) S(ani)V

ボートを5人の人が運んだ。

booto-o Gonin no hito-ga hakon-da.

boat-acc Five people-nom carried-past

'The boat (acc), Five people carried.'

I therefore carried out a picture description experiment to see whether a word order that speakers have previously comprehended affects the choice of word order when speakers describe target pictures. In addition to this, as Bock et al. (1992) found an animacy binding effect, I manipulated animacy in the prime and target pictures and ran a similar paradigm to Bock et al. (1992) to see if such an animacy binding effect occurs with respect to Japanese word order, such that participants are likely to repeat the binding of a particular animacy feature to a particular position. Recall that Bock et al. (1992) claim that the animacy binding effect is related to whether there is a tendency to repeatedly bind a particular animacy feature to a particular grammatical function (e.g., inanimate subject and animate object). However, as discussed before, it is possible that such an animacy binding effect could be interpreted as a tendency to place a particular animacy feature to a particular word order position (early in the sentence or late in the sentence). Thus, if the current study showed the animacy binding effect on word order in Japanese, it can only be interpreted as a preference for a particular word order position.

Participants

60 native speakers of Japanese were recruited in this experiment. They were all recruited from Hiroshima University, Japan. 500 yen (roughly 2.5 British pounds) were awarded to the people who successfully completed the experiments. None of them was tested in my experiments before or after this.

Materials

There were three experimental materials prepared for this experiment. For priming conditions, there were 24 sets of priming pictures and 24 sets of priming sentences. Every set of pictures contained 2 types of animacy mapping, animate agent – inanimate patient, and inanimate agent – animate patient, resulting in 48 prime pictures in total. On the other hand, every set of priming sentences included four different versions, two Subject-Object-Verb (SOV) with the mappings of animate-inanimate and inanimate-animate and two Object-Subject-Verb (OSV) with the mappings of animate-inanimate and inanimate-animate.:

(73)

a... S(ani)O(inani)V

5 人の人がボートを運んだ。

Gonin no hito-ga booto-o hakonda.

Five people-nom boat-acc carry-past

'Five people carried the boat.'

b... S(inani)O(ani)V

ボートが5 人の人を運んだ。

Booto-ga gonin no hito-o hakonda.

Boat-nom five people-acc carry-past

'The boat carried five people.'

c...O(inani) S(ani) V

ボートを5人の人が運んだ。

Booto-o gonin no hito-ga hakonda.

Boat-acc five people-nom carry-past

'The boat (Acc), five people carried.'

d...O(ani) S(inani) V

5人の人をボートが運んだ。

Gonin no hito-o booto-ga hakonda.

Five people-acc Boat-nom carry-past

'Five people (Acc), the boat carried.'

All priming pictures and sentences in each set contained the same two noun phrases, one animate and the other inanimate, and the same base verb (e.g., *The nurse dragged the fishing rod*, or *The fishing rod dragged the nurse*). Thus a priming picture like picture 1 in Figure 8 could have been described as priming sentence SOV (74-a) or OSV (74-b), and picture 2 as SOV (74-c) or OSV (74-d). All Prime-Target sentences and Filler sentences in Experiment 3 can be found in Appendix 5 and 7, and all Prime and Target pictures and Filler pictures in Experiment 3 can be found in Appendix 10 and 11

(74)

a... S(ani)O(inani)V

看護婦が釣り竿を引っ張った。

Kangofu-ga tsurizao-o hippatta

Nurse-nom fishing rod-acc drag-past

'The nurse dragged the fishing rod.'

b...O(inani) S(ani) V

釣り竿を看護婦が引っ張った。

Tsurizao-o Kangofu-ga hippatta

Fishing rod-acc Nurse-nom drag-past

'The fishing rod (acc), the nurse dragged.'

c... S(inani)O(ani)V

釣り竿が看護婦を引っ張った。

Tsurizao-ga Kangofu-o hippatta

Fishing rod-nom Nurse-acc drag-past

'The Fishing rod dragged the nurse.'

d...O(ani) S(inani) V

看護婦を釣り竿が引っ張った。

Kangofu-o Tsurizao-ga hippatta

Nurse-acc Fishing rod-nom drag-past

'The nurse (acc), the Fishing rod dragged.'

In this experiment, similar to Bock et al. (1992), participants looked at the first prime picture, followed by the prime sentence and they were asked if this sentence described the prime picture correctly. After this judgment, participants were asked to describe the target picture verbally. Every priming trial was made up of the prime pictures and sentences. However, the verbs appeared on the prime pictures may or may not have matched with the same verbs of its prime sentences. For instance, the verb '*drag*' on the prime picture in Figure 10 matched with the prime sentence '*Kangofu-ga tsurizao-o hippatta*' (*The nurse dragged*

the fishing rod). However, the verb on the prime picture may be 'touch', which did not match the verb on the prime picture 'drag' on 'The nurse dragged the fishing rod'. In this way, the participants were able to judge if the prime pictures and sentence were matched correctly.

Only the verbs on the prime sentences may or may not contain the same as the ones on the prime pictures, and two nouns were always correct ones and were never replaced with other unrelated nouns. It was always the verbs that differed for non-match prime pictures. For an experimental condition, and half the prime pictures and the prime sentences matched with the verbs and half did not match with the verbs.

(1) Priming Picture 1

(2) Priming Picture 2

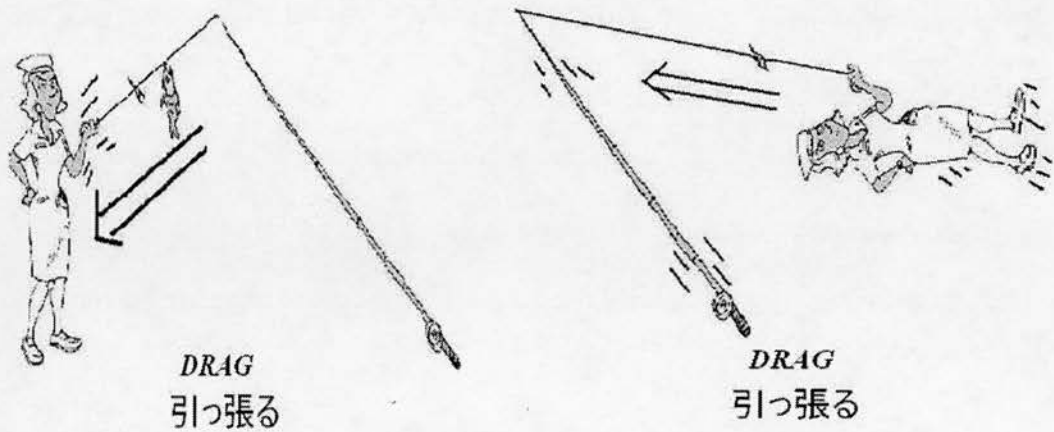


Figure 10. Examples of prime pictures that were used in Experiment 3, 4 and 5.

In addition to the priming pictures and sentences, 24 sets of target pictures were created for participants to describe verbally (these were called target sentences). As in Bock et al.'s (1992) study, compared to priming conditions, all target pictures as in Figure 11 had inanimate-agent and animate patients, such as expressing 'The screwdriver poking the conductor'. However this can be described with either an active sentence (75-a), or a passive sentence (75-b).

(75)

a. スクリュードライバーが指揮者をつついた。

Screwdriver-ga shikisha-o tsutsuita

Screwdriver-nom conductor-acc poked

'The screwdriver poked the conductor'

b. 指揮者がスクリュードライバーにつつかれた。

Shikisha-ga Screwdriver-ni tutukareta

Conductor-nom screwdriver-by was poked

'The conductor was poked by the screwdriver'

In addition to these priming and target materials, 36 pairs of filler pictures and 36 filler sentences were created for this experiment. Half of the filler pictures (18) and filler sentences (18) contained animate nouns with intransitive verbs, half of the filler pictures (18) and filler sentences (18) included inanimate nouns with intransitive verbs. Thus the filler sentences could only expressed with intransitive sentences, such as *'Kendo player-ga naita'* (The Kendo player cried) or *'Tomato-ga korogatta'* (The tomato rolled).

(1) Target Picture

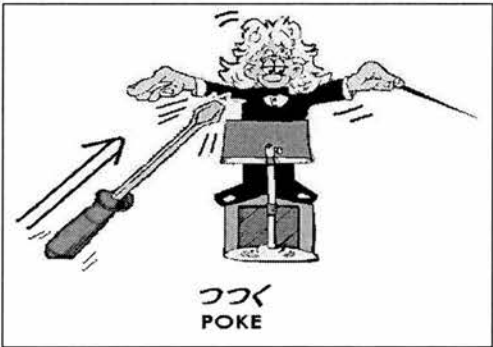


Figure 11. Examples of target picture that was used in Experiment 3, 4 and 5.

The prime sentences from each set were paired with one of the 24 target pictures, so that the same target picture accompanied all sentences from the same set. I carefully selected each pair of pictures in order to avoid semantic and pragmatic relationship between prime and target pictures. Although the same verbs were repeated twice within each priming and target condition (12 sets of priming verbs x 2 and 12 sets of target verbs x 2), the verbs between prime and target always used different verbs (e.g. 1, prime *HIT* – target *SHAKE*; 2, prime *HIT* – target *CARRY*). Once again, in order to avoid the influence of semantic and pragmatic factors on this priming task, the pairing was also designed to avoid matching the prime-target verbs, which may have led to some semantic or pragmatic similarities (e.g. *HIT* – *PUSH*). A similar restriction had to be in place for the noun combination. I carefully selected noun combinations of priming-target pairs which were not semantically related (such as avoiding *football player* – *goalkeeper* or *car* – *autobike*).

All the pictures of primes and targets contained verbs at the bottom of the pictures, and participants were asked to use these verbs to describe the pictures. The pictures were drawn in colour and taken from professional clipart (Nova Art Explosion 800,000 Clip Art).

Procedure

A picture description task was used in this experiment. This task is similar to Bock et al. (1992), but it differs because while Bock et al.'s (1992) task was production to production, the current study employed comprehension to production. In the experiment, the participants were seated in a quiet room and tested individually. They were told that the first picture (the prime picture) would be displayed on the PC screen for 6 seconds, and after it automatically disappeared, the sentence (the prime sentence) would appear on the screen. Participants were asked to press the button **Yes** or **No** to judge if this sentence described the prime

picture correctly. After this judgment, another picture (the target picture) was shown on the screen, and participants were asked to describe it verbally. The order of sentences within each block was individually randomised.

Four experimental lists were created, and the composition of each list was the same. Each of the experimental lists contained 240 items, including the fillers and the items for four priming trials. The duration of the pause between each pair of sentences was determined on the basis of a pilot study involving five participants who did not participate in any other experiments in this study. A pilot study consisted of the actual experimental trial to make sure that 6 seconds were enough to read the prime sentences and describe the target pictures.

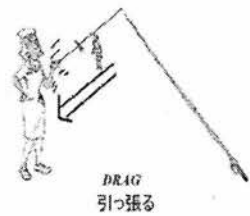
Every experimental list contained one of four sets of prime sentences. The prime sentences were separated by always two or three fillers in order to avoid repetition of the previous prime or target sentences (Bock, 1989; Bock & Kroch, 1989). Each list contained an equal number of each type of sentence in each condition. Across lists, each item was seen by 15 participants in each condition. The experimental session started with a practice block, and all the answers were recorded on MP3 audio players and subsequently transcribed. The experimental session lasted about half an hour.

Question 1 (2, 3, 4...)

Fixation 200msec

...

The prime picture (e.g, *The nurse dragged the fishing rod.*)



(6 seconds to check this picture)

...

Fixation 200msec

...

The prime sentence (e.g, *The nurse dragged the fishing rod.*)

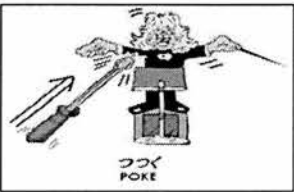
(6 seconds to judge if it matches with picture or not)

...

Fixation 200 msec

...

The target picture (always inanimate-animate SOV, *The pencil poked the magician.*)



(6 seconds to describe this picture) ...

Figure. 12. Example of the experimental trial.

Scoring

The experimental session was recorded on audio tape and subsequently transcribed. Participants' responses were grouped into 6 different categories; S(inanimate)O(animate)V, O(animate)S(inanimate)V, passives, thematic role errors, case marking errors and other errors.

(1). To be marked as S(inanimate)O(animate)V-actives, participants had to describe target pictures where NP-ga preceded NP-o with active voices, using the correct nouns and verbs, such as '*Boat-ga Gonin no hito-o hakon-da* (*The boat carried five people*)'. 'Correct' nouns and verbs meant either the exact words they heard or semantically similar (e.g., *taxi – car*). In addition to this, the animacy order in the target description had to be inanimate-animate, since this was identical to the target picture's order.

(2). To be marked as O(animate)S(inanimate)V-actives, participants had to describe target pictures with OSV orders where NP-o (accusative case marker) preceded NP-ga (nominative case marker) with active voice, such as '*Gonin no hito-o Boat-ga hakon-da* '*Five people (acc), the boat carried (OSV order)*'. These sentences had to include the correct nouns and verbs, and animacy order was also animate-inanimate.

(3). Passives were marked when participants described target pictures as passive forms with 'NP-ga (nom) – NP-oblique – passive verbs'. For instance, it was marked as a passive when a participant described the picture '*Screw driver-ga shikisha-o tutuita* (*The screw driver poked the conductor*)' as '*Shikisha-ga screw driver-ni tutukareta* (*The conductor was poked by the screw driver*)'.

(4). As in the previous recall experiments, to make a thematic role error, the sentences had to have the correct grammatical forms and word orders but both nouns (but NOT case markers) had to be the wrong

position (e.g., participants would describe target pictures with animate-agents and inanimate-patients as '*Gonin no hito-ga Booto-o hakon-da*' (Five people (nom) carried the boat (SOV)).

(5). Similarly to the scoring of the recall experiments, other errors included (a) the whole sentence was omitted (or no response), (b) one of the nouns was missing (c) both nouns were missing (only verbs were produced), (d) no verb was produced, (e) word order and grammatical functions were correct, but the nouns or verbs were semantically different (e.g., *boat* recalled as *pen*). and (f) participants produced the wrong case-marking (e.g., participants described target pictures with inanimate-agents (*boat*) and animate-patients (*five people*) as '*The boat-ga (nom) five people-ga (nom) carried*'.

(6). As in the previous recall experiments, only the first sentence they produced (first two nouns and verb) was scored. For instance, sentences such as '*Five people went to the sea and carried the boat*' were excluded from correct answers and counted as other errors. Sentences containing verbs which expressed actions done by the inanimate-agent such as (76) were counted as other errors.

(76)

Booto-o hakonde-iru Gonin no hito

Boat-acc carry-ing five people

'Five people carrying the boat'

My analyses here were similar to those in the previous recall experiments in chapter 3: I examined the proportions of three different responses, SOV-actives, OSV-actives, and SOV-passives that were produced by participants. For instance, even when the prime sentence was an OSV order, participants still sometimes described the target picture as an SOV order. By examining the proportion of SOV orders and OSV orders,

we were able to see the reflection of word order priming (the priming effects of SOV and OSV). In addition, by examining the proportion of passive-SOVs, we were able to look at what caused the passive responses in each condition.

I computed the relevant proportions of response types (SOV-actives, OSV-actives, SOV-passives) by dividing the numbers of SOV answers by the total numbers of the three responses (i.e., SOV-actives, OSV-actives, and SOV-passives), by dividing the numbers of OSV-actives by the total numbers of the three responses, and by dividing the numbers of SOV-passives by the total numbers of the three responses. These proportions were calculated for each participant and each item. In the current study, I carried out analyses of variance (ANOVAs) with separate analyses which treated participants (F1) and items (F2) as random effects. Both analyses were within-participants and within –items.

4.5. The results of Experiment 3

Table 7 shows the raw numbers of all responses in Experiment 3, and Table 8 shows the proportions of SOV, OSV and SOV-Passive sentences produced when participants described target pictures¹. I performed analyses of variance (ANOVA) treating both participants (F1) and items (F2) as random effects on the proportions of three different responses. First of all, the proportions of SOV responses were examined. Two (prime word order: SOV/OSV) x two (animacy of word order: animate-inanimate/inanimate-animate) ANOVAs were performed and revealed a main effect of prime word order ($F(1, 59) = 10.15$, $MSe = 0.158$, $p < .01$; $F(1, 23) = 5.51$, $MSe = 0.04$, $p < .05$). However, the main effect of animacy of word order was not significant ($F(1, 59) = 0.05$, $MSe = 0.001$, $p > .1$; $F(1, 23) = 1.537$, $MSe = 0.01$, $p > .1$). The interaction of

¹ It was possible for participants to produce OSV-passive sentences in this experiment. However, they did not produce such responses in experiment 3. Therefore the proportion of OSV-passives was excluded from the results and analyses. However, this scoring category was added into analyses of Experiment 4.

prime word order by animacy of word order was not significant either ($F(1, 59) = 0.76$, $MSe = 0.001$, $p > .1$; $F(1, 23) = .01$, $MSe = 0.01$, $p > .1$). Inspection of Table 6 suggests that participants were more likely to produce SOV responses (88%) after SOV primes than after OSV primes (83%).

Table 7. Raw numbers of all responses in Experiment 3

<i>Target responses</i>	Active		Passive	Errors	
	S(in)O(an)	O(an)S(in)	S(an)O(in)	Thematic	Others
<i>Prime conditions</i>					
(1)s(an)o(in) active	273	25	18	6	38
(2)s(in)o(an) active	290	17	18	13	22
(3)o(an)s(in) active	273	32	20	12	23
(4)o(in)s(an) active	267	33	17	13	30

Note: **S(an)O(in)V-Passive** means passive description of target pictures. **Thematic error** means that participants described target pictures with correct nouns and appropriate syntactic structures, but with the thematic roles assigned to the nouns reversed, such as ‘*Five people carried the boat*’ instead of ‘*The boat carried five people.*’ **ERRORs** means including total omission of responses, either nouns or verbs were incorrect or missing, and misuse of case marking.

Table 8. Proportions of each responses in Experiment 3

<i>Target responses</i>	Active		Passive
	S(in)O(an)	O(an)S(in)	S(an)O(in)
<i>Prime conditions</i>			
(1)s(an)o(in) active	0.87	0.07	0.06
(2)s(in)o(an) active	0.89	0.05	0.06
(3)o(an)o(in) active	0.84	0.1	0.07
(4)o(in)s(an) active	0.82	0.11	0.07

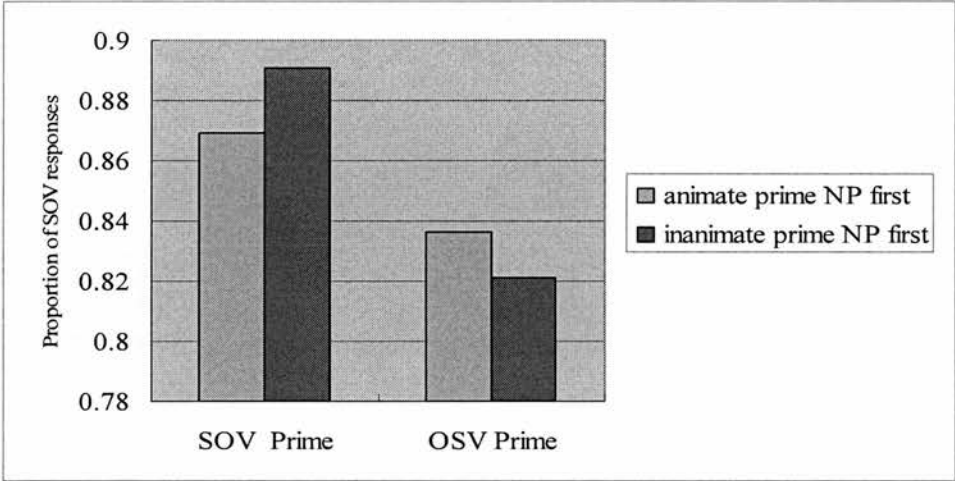


Fig. 13. Proportion of SOV responses in Experiment 3

Secondly, the proportion of OSV responses was examined. A two (prime word order: SOV/OSV) x two (animacy of word order: animate-inanimate/inanimate-animate) ANOVA revealed a main effect of prime word order ($F(1, 59) = 10.25$, $MSe = 0.119$, $p < .01$; $F(1, 23) = 5.38$, $MSe = 0.031$, $p < .05$). However, the main effect of animacy of word order was not significant once more ($F(1, 59) = .13$, $MSe = 0.002$, $p > .1$; $F(1, 23) = .60$, $MSe = 0.004$, $p > .1$). The interaction of prime word order by animacy of word order was not significant either ($F(1, 59) = 1.13$, $MSe = 0.024$, $p > .1$; $F(1, 23) = 0.78$, $MSe = 0.002$, $p > .1$). Inspection of Table 6 shows that participants were more likely to produce OSV responses after OSV primes (10.5%) than after SOV primes (6%).

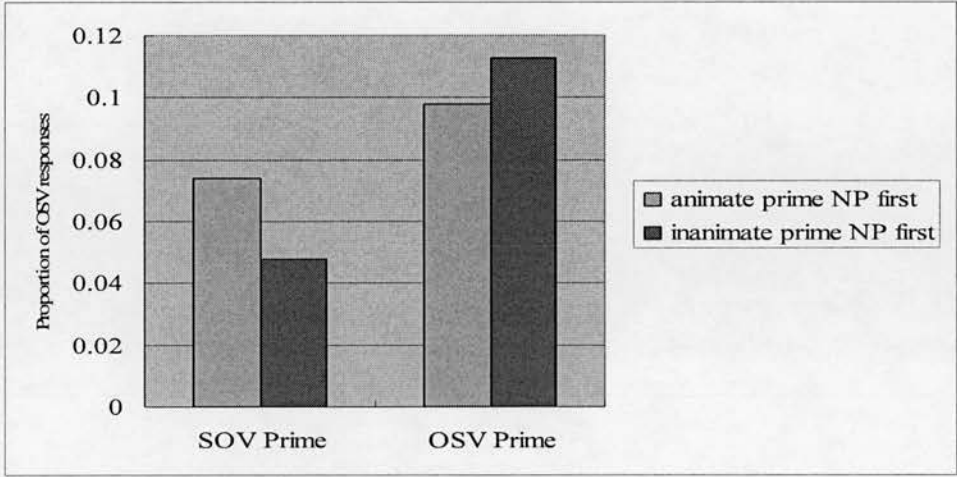


Fig. 14. Proportion of OSV responses in Experiment 3

Thirdly, the proportion of SOV-passives was examined. Two (prime word order: SOV/OSV) x two (animacy of word order: animate-inanimate/inanimate-animate) ANOVAs revealed that in all three analyses, the main effects were not significant (the main effect of prime word order: $F(1, 59) = .52$, $MSe = 0.003$, $p > .1$; $F(1, 23) = .11$, $MSe = 0.001$, $p > .1$; The main effect of animacy of word order: $F(1, 59) = .03$, $MSe = 0.001$, $p > .1$; $F(1, 23) = .18$, $MSe = 0.001$, $p > .1$; The interaction of prime word order by animacy of word order: $F(1, 59) = .03$, $MSe = 0.001$, $p > .1$; $F(1, 23) = .38$, $MSe = 0.003$, $p > .1$).

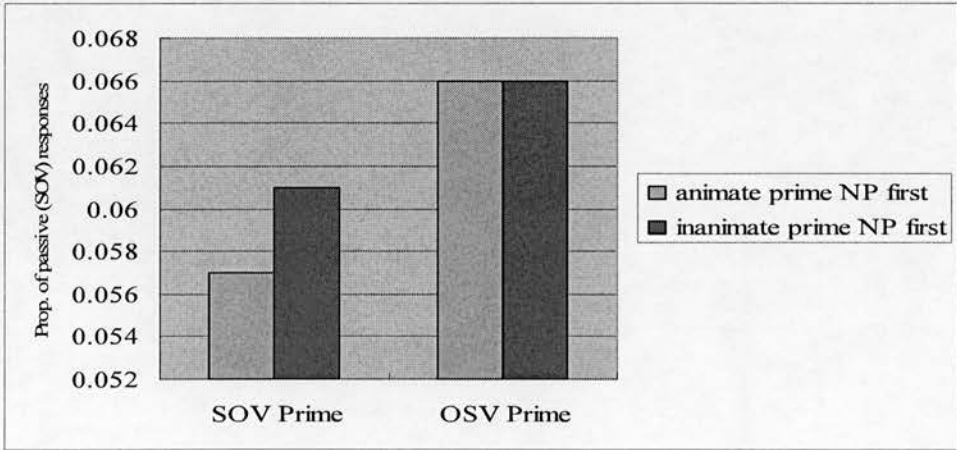


Fig. 15. Proportion of SOV-Passive responses in Experiment 3

In order to justify this result, I examined the proportions of other errors and thematic role errors. These results showed that the current results were not due to the numbers of errors. I computed the relevant proportions by dividing the numbers of other errors and thematic role errors by the total numbers of responses. These proportions were calculated for each participant and each item. I carried out analyses of variance (ANOVAs) with separate analyses which treated participants (F1) and items (F2) as random effects. Both analyses were within-participants and within-items. ANOVAs on the proportion of other errors and thematic role errors revealed that none of the effects achieved significance (All $F < .1$). Table 9 shows the proportions of other errors and thematic role errors in Experiment 3.

Table 9. Proportions of other errors and thematic role errors in Experiment 3

<i>Target responses</i>	Other errors	Thematic role errors
<i>Prime conditions</i>		
(1)s(an)o(in) active	0.11	0.02
(2)s(in)o(an) active	0.06	0.04
(3)o(an)o(in) active	0.06	0.03
(4)o(in)s(an) active	0.08	0.04

4.6. Discussion of Experiment 3

The results of Experiment 3 confirmed that, first of all, there was a tendency towards word order priming: speakers were more likely to describe target pictures with SOV orders after SOV primes than after OSV primes, or with OSV orders after OSV primes than after SOV primes. Such a result strongly suggests a syntactic priming effect. In fact, there have been several studies suggesting that syntactic priming effect occurs in other languages (Hartsuiker & Kolk, 1998; Scheepers, 2003). The result of the current Experiment showed that syntactic priming also occurs in Japanese.

Furthermore, this result seems compatible with finding by Hartsuiker and Westenberg (2000), who showed priming of word orders of auxiliary verb and past participle in Dutch. The result in Experiment 3 showed that Japanese word order (SOV/OSV) primed, suggesting that the current finding is consistent with the results of Dutch studies by Hartsuiker and Westenberg (2000).

The results of Experiment 3 fit with those of Bock et al. (1992) in not showing any interactions between animacy-binding and syntactic priming effects. However, in contrast to Bock et al. (1992), the results of Experiment 3 revealed that there was no animacy-binding effect: there was no tendency to place a particular animacy in a particular position (early in the sentence vs. late in the sentence). Recall that Bock et al. (1992) specifically claimed that their effect is to do with animacy-binding to particular grammatical functions (e.g., animate-subject vs. animate-object). This happened irrespective of syntactic structures (in their case actives versus passives). Thus, the results of Experiment 3 regarding the animacy binding effect were not compatible with those shown by Bock et al. (1992).

Such a result supports the finding by Pickering et al. (2002). To recall, they found that people tended to repeat the PO form when they had just produced a PO form with the constituents in the same order, but not when they had just produced heavy-shifted PO. Thus this suggests that there is no tendency to repeat constituents without also repeating their orders. This view is consistent with the extended model of the lemma stratum by Branigan et al. (2008), that there may be separate combinatorial nodes corresponding to the same constituent structure differing in word order alone. This issue will be returned to in the General Discussion.

However, while Bock et al. (1992) examined such an animacy-binding effect with English sentences that differed in voice (active-passive), the current Experiment examined Japanese sentences that differed in

word order (SOV-OSV) and it may be possible that such a difference might cause some difference of the results. Thus, the next experiment will investigate this issue in Japanese sentences that differed in voice.

In conclusion, the current study confirmed the effect of syntactic priming in Japanese, following SOV and OSV sentences. Although I did not find any animacy-binding effect in Experiment 3, the results of Experiment 3 also extended the finding by Hartsuiker and Westenberg of word order priming in Dutch to Japanese.

4.7. Experiment 4 on active/passive priming

Experiment 4 was designed to test the priming of actives/passives in Japanese. SOV sentences used in Experiment 3 were used as SOV-actives in Experiment 4, and OSV sentences presented in Experiment 3 were turned into SOV-passive sentences. The rest of the experimental conditions (e.g., pictures, conditions) were identical to Experiment 3 (unless otherwise stated).

As the expected results in Experiment 4, I would expect that a voice structure that speakers have previously comprehended affects the choice of voice structure when they describe target pictures: participants were more likely to describe target pictures with the active sentences after active primes than passive primes, or with the passive sentences after passive primes than active primes. Additionally, if Bock et al. (1992) claim that the animacy binding effect is related to whether there is a tendency to repeatedly bind a particular animacy feature to a particular grammatical function (e.g., inanimate subject and animate object) was right, I would expect to see the same pattern that participants would be more likely to produce a description with an inanimate subject after reading a prime with an inanimate subject than with an animate subject irrespective of syntactic structure. Or, as in Experiment 3, if there was no such tendencies to bind or

place particular animacy features to particular grammatical functions or word order positions, I would expect to see no animacy binding effect in Experiment 4.

Participants

I recruited 60 participants who were all Japanese native speakers from Hiroshima University, Japan. As in Experiment 3, they were all recruited in Japan. 500 yen (2.5 British pounds) were awarded to the people who successfully completed their experiments. They did not participate in any other experiments that I conducted.

Materials

The experimental materials in Experiment 3 were the same as in Experiment 4, except that the OSV conditions were replaced with SOV-passive conditions. There were 24 sets of prime pictures and 24 sets of prime sentences, and 24 sets of target pictures and 36 fillers (all intransitives, 18 sentences with animate nouns, 18 with inanimate nouns). Appendix 6 and 7 contain Experiment 4 Prime-Target sentences and Experiment 4 Fillers, and Appendix 10 and 11 contain Experiment 4 – Prime and Target pictures and Experiment 4 Filler pictures.

However, in terms of prime sentences, SOV sentences from Experiment 3 were retained as the active sentences, and OSV sentences were replaced with the passive sentences in Experiment 4. Thus in Experiment 4, the following 4 types of prime sentences were tested;

(77)

a... S(ani)O(inani)V

5 人の人がボートを運んだ。

Gonin no hito-ga booto-o hakonda.

Five people-nom boat-acc carry-past

'Five people carried the boat.'

b... S(inani)O(ani)V

ボートが5 人の人を運んだ。

Booto-ga gonin no hito-o hakonda.

Boat-nom five people-acc carry-past

'The boat carried five people.'

c... S(ani)O(inani)-oblique V [passive]

5 人の人がボートによって運ばれた。

Gonin no hito-ga booto-niyotte hakobareta.

Five people-nom boat-obl carry-pas-past

'Five people were carried by the boat.'

d... S(inani)O(ani)-oblique V [passive]

ボートが5 人の人によって運ばれた。

Booto-ga gonin no hito-niyotte hakobareta.

Boat-nom five people-obl carry-pas-past

'The boat was carried by five people.'

Procedure

The procedure was exactly the same as in Experiment 3.

Scoring

The scoring rules were also the same as in Experiment 3. However I added one more category:

O(inanimate)S(animate)V-passive:

(1). In Japanese it was possible for participants to produce OSV-passive sentences since the word order of passive forms could also be changed. Thus, to be marked as O(inanimate)S(animate)V-passive, participants described target pictures with OSV-passive orders where NP-ni (oblique (by-phrase) in Japanese) preceded NP-ga (nominative case marker), as in 'Boat-ni (NP-oblique), Gonin no hito-ga (NP-nom) hakobareta (verb-passive-past)' (*By the boat, five people were carried (OSV passive order)*). These sentences had to include the correct nouns and verbs, and the animacy order was also inanimate-animate.

In Experiment 4, there were four different types of proportions, SOV-active, SOV-passive, OSV-active, and OSV-passive. I computed the relevant proportions (SOV-actives, SOV-passives, OSV-actives and OSV-passives) by dividing the numbers of SOV answers by the total numbers of the four types of responses (i.e., SOV-actives, SOV-passives, OSV-actives and OSV-passives), by dividing the numbers of OSV-actives by total numbers of the four responses, by dividing the numbers of SOV-passives by total numbers of the four responses, and by dividing the numbers of OSV-passives by total numbers of the four responses (SOV-actives, SOV-passives, OSV-actives and OSV-passives). These proportions were calculated for each participant and each item. In the current study I performed analyses of variance

(ANOVAs) with separate analyses which treated participants (F1) and items (F2) as random effects. Both analyses were within-participants and within-items.

4.8. Results of Experiment 4

Analyses of variance (2 (prime voice: active/passive) x 2 (animacy of subject: animate/inanimate)) were performed. The first analysis was on the proportion of SOV-actives responses. It revealed that the main effect of prime voice was significant ($F(1, 59) = 12.47$, $MSe = 0.72$, $p < .001$; $F(1, 23) = 16.81$, $MSe = 0.42$, $p < .001$). However, once again, the main effect of animacy of subject was not significant ($F(1, 59) = .07$, $MSe = 0.01$, $p > .1$; $F(1, 23) = .22$, $MSe = 0.01$, $p > .1$). Furthermore, there was no interaction here ($F(1, 59) = 1.49$, $MSe = 0.07$, $p > .1$; $F(1, 23) = 1.25$, $MSe = 0.02$, $p > .1$). Inspection of Table 11 suggests that participants produced more active responses after active primes (81.5%) than after passive primes (71%).

Table 10: Raw numbers of all responses in Experiment 4

Target responses	Active		Passive		Errors	
	s(in)o(an)	O(an)S(in)	S(an)O(in)	O(in)S(an)	Thematic	Others
Prime conditions						
(1)s(an)o(in) active	253	8	42	4	16	37
(2)s(in)o(an) active	257	16	32	4	9	42
(3)s(an)o(in) passive	226	7	71	4	7	44
(4)s(in)o(an) passive	208	9	82	1	10	50

Table 11: Proportions of SOV-actives, SOV-passives, OSV-active and OSV-passives in Experiment 4

Target responses	Active		Passive	
	s(in)o(an)	O(an)S(in)	S(an)O(in)	O(in)S(an)
Prime conditions				
(1)s(an)o(in) active	0.80	0.03	0.15	0.01
(2)s(in)o(an) active	0.83	0.05	0.10	0.01
(3)s(an)o(in) passive	0.73	0.02	0.24	0.02
(4)s(in)o(an) passive	0.69	0.03	0.28	0.01

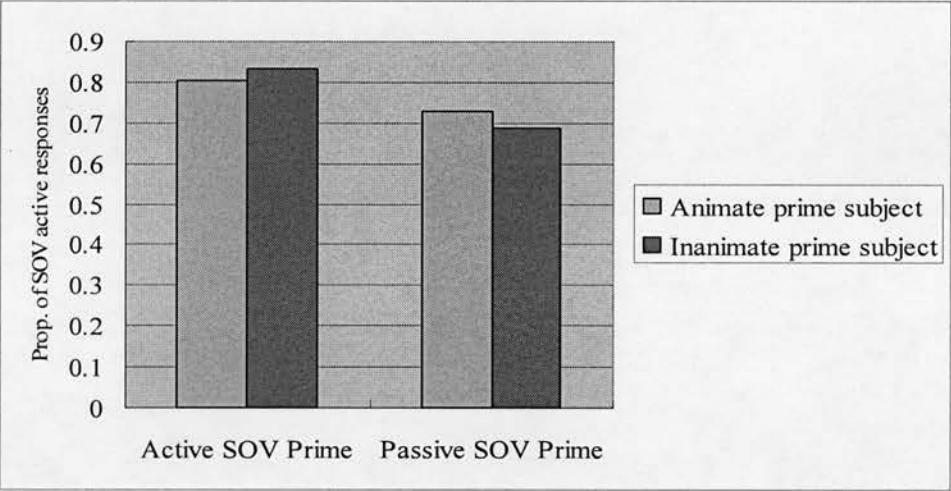


Fig. 16: Proportion of SOV-active responses in Experiment 4.

Secondly, the proportion of Passive (SOV) answers was analysed. The ANOVA revealed that the main effect of prime voice was significant ($F(1, 59) = 18.86$, $MSe = 1.05$, $p < .001$, $F(1, 23) = 22.70$, $MSe = 0.576$, $p < .001$). However, the main effect of animacy of subject was not significant ($F(1, 59) = .01$, $MSe = 0.01$, $p > .1$; $F(1, 23) = .06$, $MSe = 0.01$, $p > .1$). Contrary to the analysis of the proportion of SOV-actives, the interaction of prime voice by animacy of subject first was marginal ($F(1, 59) = 2.09$, $MSe = 0.144$, $p = .094$; $F(1, 23) = 3.68$, $MSe = 0.04$, $p = .068$). Inspection of Table 11 suggests that participants produced more passive responses after passive primes (26%) than after active primes (12.5%).

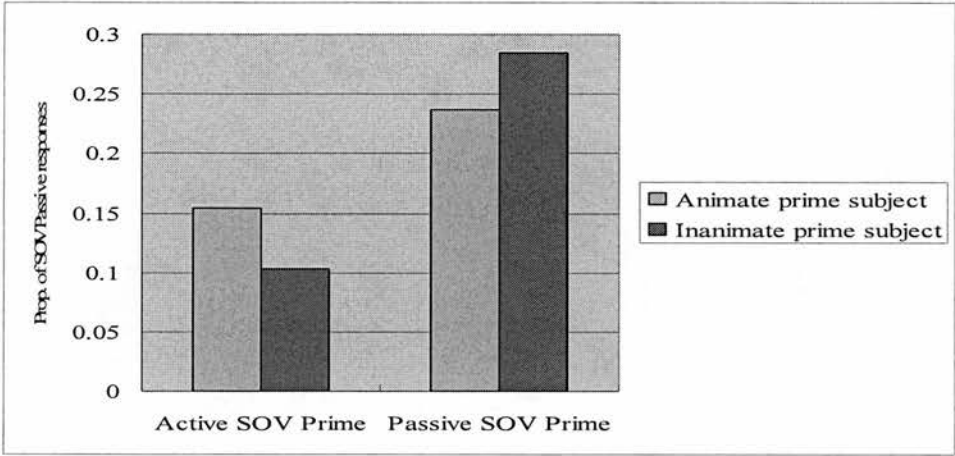


Fig. 17: Proportion of SOV-passive responses in Experiment 4.

The third analysis was on the proportion of OSV (animate-inanimate active) answers. The ANOVA revealed that none of the main effects were significant (the main effect of prime voice: $F(1, 59) = 2.20$, $MSe = 0.02$, $p > .1$; $F(1, 23) = 2.08$, $MSe = 0.01$, $p > .1$; the animacy of subject: $F(1, 59) = 1.78$, $MSe = 0.01$, $p > .1$; $F(1, 23) = 2.50$, $MSe = 0.01$, $p > .1$: the interaction of prime voice by animacy of subject was not significant: $F(1, 59) = 1.05$, $MSe = 0.01$, $p > .1$; $F(1, 23) = .70$, $MSe = 0.01$, $p > .1$). Inspection of Table 11 suggests that participants produced more OSV responses after OSV primes (4%) than after SOV primes (2.5%).

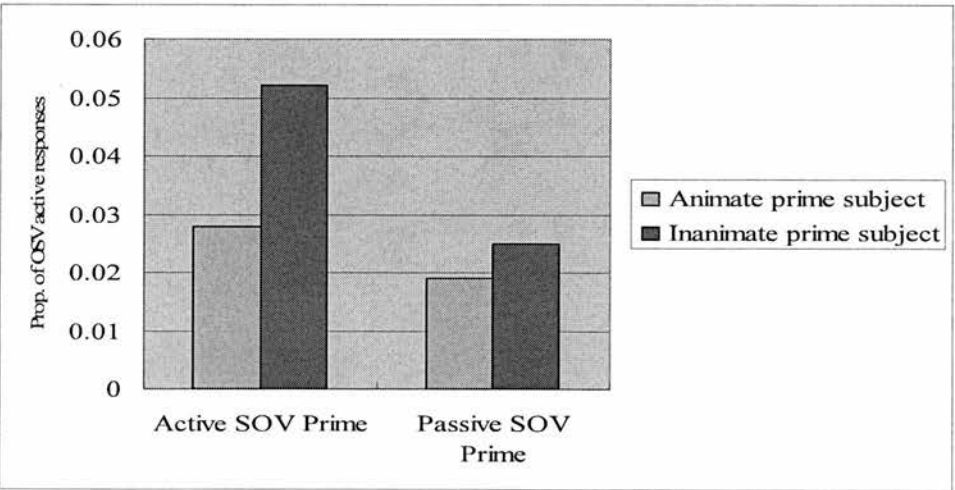


Fig. 18: Proportion of OSV-active responses in Experiment 4.

The last analysis was on the proportion of Passive (OSV inanimate-animate) answers. As in the analysis of OSV-active proportions, none of the main effects were significant (the main effect of prime voice: $F(1, 59) = .49$, $MSe = 0.01$, $p > .1$; $F(1, 23) = .09$, $MSe = 0.01$, $p > .1$; animacy of subject: $F(1, 59) = 1.03$, $MSe = 0.01$, $p > .1$; $F(1, 23) = .70$, $MSe = 0.01$, $p > .1$; the interaction of prime voice by animacy of subject: $F(1, 59) = 2.85$, $MSe = 0.01$, $p > .1$; $F(1, 23) = 1.53$, $MSe = 0.01$, $p > .1$).

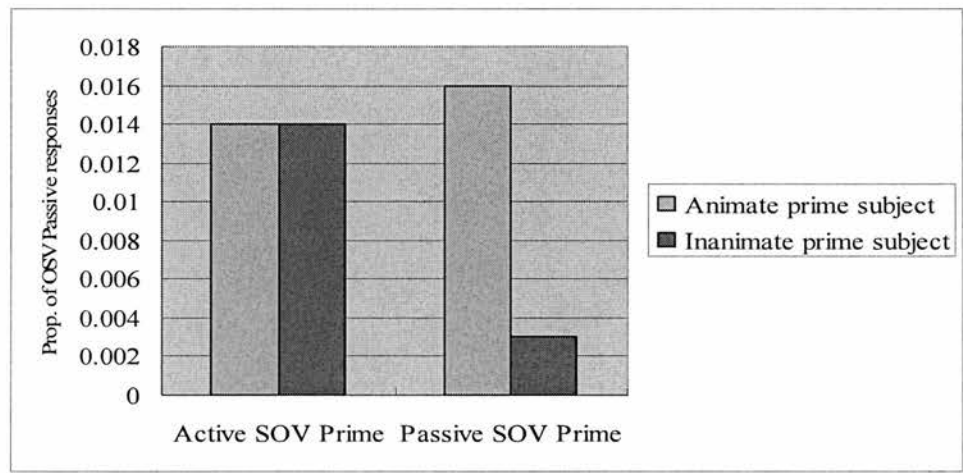


Fig. 19: Proportion of OSV-passive responses in Experiment 4.

As in Experiment 3, I examined the proportions of other errors and thematic role errors in order to see if error data affect the proportions of each responses in Experiment 4. Similar to Experiment 3, I computed the relevant proportions by dividing the numbers of other errors and thematic role errors by the total numbers of responses. These proportions were calculated for each participant and each item. I carried out analyses of variance (ANOVAs) with separate analyses which treated participants (F1) and items (F2) as random effects. Both analyses were within-participants and within-items. As in Experiment 3, ANOVAs on the proportion of other errors and thematic role errors revealed that none of the effects achieved significance (All $F < .1$). Table 12 shows the proportions of other errors and thematic role errors in Experiment 4.

Table 12. Proportions of other errors and thematic role errors in Experiment 4

<i>Target responses</i>	Other	Thematic
	errors	role errors
<i>Prime conditions</i>		
(1)s(an)o(in) active	0.10	0.04
(2)s(in)o(an) active	0.12	0.03
(3)s(an)o(in) passive	0.12	0.02
(4)s(in)o(an) passive	0.14	0.03

4.9. Discussion of Experiment 4

The results of Experiment 4 were similar to the ones in Experiment 3. First of all, the results of Experiment 4 confirmed the syntactic priming effect: when the prime sentences were actives, Japanese speakers tended to describe target pictures as active forms, and when they were passive forms they tended to describe them with passive forms. Thus, together with the finding of word order priming in Experiment 3, such a result confirms the syntactic priming effect in Japanese.

Once again I did not find any interactions between animacy-binding and syntactic priming effects. Looking at the animacy-binding effect, I once again found that there was no animacy binding effect: there was no tendency to bind particular animacy features to particular grammatical functions. Thus, participants were more likely to produce a description with an inanimate subject after repeating a prime with an inanimate subject as equally as a prime with an animate subject. This result was consistent with the results of Experiment 3, that there was no animacy-binding effect - no tendency to place a particular animacy feature in a particular position.

This seems inconsistent with the results of recall experiments in Experiment 1 and 2. The recall experiments showed the animacy effect, suggesting that people would always produce OSV or passive

sentences when, for instance, it is inanimate agents and animate patients, irrespective of the prime sentence. In terms of animacy-binding effect (Experiment 3, 4 and 5), people would produce OSVs or passives (i.e., animate-first) more after hearing an animate-first prime sentence than inanimate-first prime sentence. In other words, there would be priming effect of animate-first in the sentence. Thus, the definitions of the animacy effect and the animacy-binding effect are slightly different, and the current findings in Experiment 3 and 4 are not against the results of Experiment 1 and 2.

In addition, as the previous Experiment showed, Experiment 4 demonstrated that there were no significant interactions between animacy-binding and syntactic priming effects (only the proportion of SOV-passives, and the participants analysis in the proportion of OSV-passives showed a marginal effect). Thus, the difference between the finding between Experiment 3-4 and Bock et al. (1992) was not due to the difference of structures that I tested.

Once again, such a finding is consistent with the extended model of the lemma stratum proposed by Branigan et al. (2008, also Pickering & Branigan, 1998; Pickering et al., 2002). Recall that Hartsuiker et al. (2004) found the priming effect from active to active, and from passive to passive between Spanish and English bilinguals. Such a finding is consistent with the view that there is the existence of the combinatorial node (active and passive) linked to the relevant lemma. I will return to this issue in General discussion.

It is important to note that there was a slight difference of methodologies between Bock et al.'s (1992) and the current two studies in Japanese. Recall that Bock et al. used a 'production-to-production' method (where participants read out prime sentences and described target pictures), the two Experiments in Japanese used a 'comprehension to production' method (speakers read prime sentences silently and described target pictures orally). The slight difference between these two methodologies may have caused

the differences reported here (I will discuss this issue in the discussion section).

Apart from the methodological issue, while Bock et al. (1992) conducted such priming experiment in English, the 2 Experiments that I conducted here were in Japanese. Thus lack of animacy-binding effects in both Experiment 3 and 4 may be due to the difference of languages. Experiment 5 will examine such an issue. In conclusion, the current study confirmed the effect of syntactic priming in Japanese, this time with Japanese voice structure, following active prime sentences, and passive prime sentences.

4.10. General discussion of Experiments 3 and 4

Two Experiments run in Japanese clearly demonstrated three important findings. First of all, the effect of syntactic priming was robust in Japanese. I confirmed not only the priming effect of voice (actives after actives, passives after passives), but the effect of word order priming, where speakers tended to describe target pictures with previously comprehended word orders (SOV orders after SOV, OSV after OSV).

This is related to the stages of syntactic priming during language production. Since Bock et al.'s study, there have been conflicting views on how such priming effects can be interpreted. Since it is difficult to test grammatical function assignment and word order separately in English, it may be difficult to identify how the animacy-binding effect found by Bock et al. can be interpreted. However, the results of Experiments 3 and 4 in Japanese clearly demonstrated the effects of word order priming and voice priming. There are two possibilities here. Firstly, since the existing models of language production (e.g., Bock & Levelt, 1994; Garrett, 1980) assume that the functional level is responsible for the processing of actives/passives, and that the positional level determines the word order variation such as SOV or OSV, the results of the current studies suggest that the priming effects of voice and word order would take place in the functional and the

positional levels respectively. However, as I discussed in chapter 3, Kempen and Harbusch (2004) noted that such a hypothesis may be ‘unparsimonious’ (Branigan et al., 2008).

Thus the results in Experiment 3 and 4 are compatible with an alternative model proposed by Branigan et al. (2008), where grammatical function assignment and word order are determined during a single stage of processing. Pickering and Branigan (1998) adopted Levelt et al.’s (1999) theory of lexical access and proposed the lexico-syntactic representation in production that the lemma is linked with the combinatorial node of verb lemma.

The second finding was the lack of an animacy-binding effect. Contrasting with Bock et al.’s finding, the current studies in Japanese clearly showed that there was no tendency to bind or place particular animacy features to particular grammatical functions or particular positions. Bock et al.’s original claim was that the animacy binding effect was due to the tendency to bind particular animacy features to particular grammatical functions (e.g., inanimate-subject and animate-object). Such an effect could also be interpreted as a preference to place particular animacy features to the particular word order positions (early in the sentence or late in the sentence). However, the results in Experiment 3 and 4 showed no animacy binding effect, which demonstrated that there was no tendency to bind or place particular animacy features to particular grammatical functions or word order positions.

Such a finding may not be consistent with the results of recall experiments in Experiment 1 and 2, showing that animacy influences the choice of grammatical function assignment and word order in Japanese. However, the results of the recall experiments showed that people would always produce OSV or passive sentences when they have inanimate subjects, irrespective of the prime sentence. In contrast, the animacy-binding effect (Experiment 3 and 4) means that there would be priming effect that people would

produce OSVs or passives (i.e., animate-first) more after hearing an animate-first prime sentence than inanimate-first prime sentence. Thus, the definitions of the animacy effect and the animacy-binding effect are slightly different, and the current findings in Experiment 3 and 4 are not comparable with the results of Experiment 1 and 2.

The third finding was that none of the analyses in Experiment 3 and 4 showed any interactions between the animacy-binding and syntactic priming effects (except Experiment 4, where the main analyses revealed a weak tendency for participants to produce OSV-passives than SOV-passives after they read OSV-passives, marginal effect by participants only).

I will now consider why these two Experiments in Japanese failed to show any animacy-binding effects. First of all, the difference between Bock et al.'s (1992) results and the current ones could be due to the slight difference in methodologies. Recall that Bock et al. (1992) used a production-to-production methodology (where participants read out prime sentences and described target pictures), the two Experiments in Japanese used a method from comprehension to production (speakers read prime sentences silently and described target pictures orally). The slight difference between these two methodologies may have caused the differences reported here (I will discuss this issue in the discussion section).

Secondly, it is also possible that such differences were due to the difference in languages. Since I tested the syntactic priming effect in Japanese and Bock et al.'s (1992) study was in English, such language differences could have caused the different results. In order to investigate this issue, the next Experiment was carried out in English.

4.11. Experiment 5: active/passive priming in English

Experiment 5 was designed to test the syntactic priming effect of actives/passives in English. Since Experiment 5 aimed to test the difference between Japanese and English, I used the same materials (pictures) and conditions (number of subjects, procedure, analysis) as in the Japanese Experiment, except that the prime sentences and the verbs in the pictures in Japanese were all translated into English.

Participants

I recruited 60 participants who were all native English speakers from the University of Edinburgh, UK. 500 yen (2.5 British pounds) were awarded to the people who successfully completed their experiments. They did not participate in any other experiments that I conducted.

Materials

I re-used all the materials from Experiment 4. However, all the verbs at the bottom of the prime and target pictures, prime sentences and fillers in Japanese were replaced with English translations. As in Experiment 4, the following 4 types of prime sentences were tested as in (78);

- (78)
- a... S(ani)O(inani)V-Active
- 'Five people carried the boat.'*

b... S(inani)O(ani)V-Active

'The boat carried five people.'

c... S(ani)O(inani)-oblique V-Passive

'Five people were carried by the boat.'

d... S(inani)O(ani)-oblique V-Passive

'The boat was carried by five people.'

Procedure

The procedure was exactly the same as in Experiments 3 and 4.

Scoring

The scoring rules were also the same as in Experiment 4. However, unlike in Experiments 3 and 4, there were only two proportions that I was concerned with: the proportions of SVO-actives and SVO-Passives, since it was not grammatical for English speakers to produce OSV sentences. Thus, I computed the relevant proportions (SVO-actives and SVO-passives) by dividing the numbers of SVO answers by the total number of the two responses (i.e., SVO-actives and SVO-passives), and by dividing the numbers of SVO-passives by the total numbers of the two responses. These proportions were calculated for each participant and each item. However, since there were only two types of proportions available, I decided to report the proportion of actives in order to compare the current result with the results of other Japanese studies (Experiment 3, 4 and 5) and Bock et al's (1992) result. Thus the current analysis only

reports the proportion of SVO-actives. As in Experiments 3 and 4, for this study I performed analyses of variance (ANOVAs) with separate analyses which treated participants (F1) and items (F2) as random effects. Both analyses were within-subjects and within –items.

4.12. Results of Experiment 5

As in Experiments 3 and 4, analyses of variance (2 (prime voice: active/passive) x 2 (animacy of subject: animate/inanimate or inanimate/animate)) ANOVAs were performed to analyse the data. The main effect of prime active sentence was significant ($F(1, 59) = 24.09, P<.001; MSe = 1.03, F(1, 23) = 39.85, MSe = 0.44, P <.001$). However, as in Experiment 4, the main effect of animacy of subject was not significant ($F(1, 59) = .15, MSe = 0.01, p>.1; F(1, 23) = .33, MSe = 0.01, p>.1$). There was no interaction either ($F(1, 59) = .11, MSe = 0.01, p>.1, F(1, 23) = .07, MSe = 0.01, p>.1$). Table 13 shows the raw numbers of all responses in Experiment 5 and Table 14 and Figure 20 shows the proportions of SOV-Active sentences produced when participants described target pictures and they show that participants produced more Active responses after an Active prime (89.5%) than after a Passive prime (76.5%).

Table 13. Raw figures of all responses in Experiment 5

	Active	Passive	Errors	
	in-an	an-in	Thematic	Others
<i>Target responses</i>				
<i>Prime conditions</i>				
(1) ani-in active	296	33	8	23
(2) in-ani active	300	37	2	21
(3) ani-in passive	251	74	10	25
(4) in-ani passive	243	77	11	29

Table 14. Proportions of Correct and Word order inversion responses in Experiment 5

Target responses	Active	Passive
	in-an	an-in
Prime conditions		
(1) ani-in active	0.9	0.1
(2) in-ani active	0.89	0.11
(3) ani-in passive	0.77	0.23
(4) in-ani passive	0.76	0.24

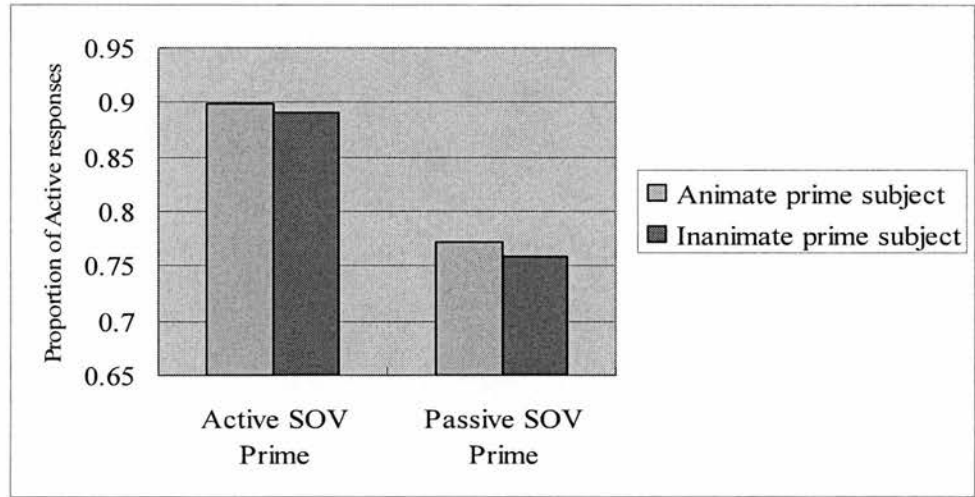


Fig. 20: Proportion of active targets in Experiment 5.

As in Experiment 3 and 4, I examined the proportions of other errors and thematic role errors in order to see if error data affect the proportions of each response in Experiment 5. Following Experiment 3 and 4, I similarly computed the relevant proportions by dividing the numbers of other errors and thematic role errors by the total numbers of responses. These proportions were calculated for each participant and each item. I carried out analyses of variance (ANOVAs) with separate analyses which treated participants (F1) and items (F2) as random effects. Both analyses were within-participants and within-items. As in Experiment 3 and 4, ANOVAs on the proportion of other errors and thematic role errors revealed that none

of the effects achieved significance (All $F < .1$). Table 15 shows the proportions of other errors and thematic role errors in Experiment 5.

Table 15. Proportions of other errors and thematic role errors in Experiment 5

<i>Target responses</i>	Other errors	Thematic role errors
<i>Prime conditions</i>		
(1)s(an)o(in) active	0.06	0.02
(2)s(in)o(an) active	0.06	0.01
(3)s(an)o(in) passive	0.07	0.03
(4)s(in)o(an) passive	0.08	0.03

4.13. Discussion

The results of Experiment 5 in English were identical to the ones in the Japanese study (Experiment 4). The strong effect of syntactic priming was confirmed: the participants were more likely to describe target pictures with active structures after active primes than after passive primes, or with passive structures after passive primes than after active primes. This demonstrates the syntactic priming effect.

More importantly, like the two Japanese Experiments (Experiment 3 and 4), the results of Experiment 5 in English did not find an animacy-binding effect: There was no tendency to bind particular animacy features to particular grammatical functions irrespective of syntactic structures. Thus, it was identical to the result of the two Japanese studies in Experiments 3 and 4. In addition to this, Experiment 5 also failed to show any significant interactions between animacy-binding and syntactic priming effects, as in the two Japanese studies.

Overall, the findings of Experiment 5 demonstrated exactly the same as the ones in Experiments 3 and

4. They showed that the effect of syntactic priming and the lack of animacy-binding effects in Japanese studies were not due to the difference in languages (between Japanese and English).

4.14. General Discussion of Experiment 3, 4, 5

The three experiments using syntactic priming tasks in Japanese and English demonstrated some important findings. First of all, the three experiments all confirmed the syntactic priming effect; Experiment 3 showed that Japanese word order variations such as SOV or OSV were primed; Experiment 4 also confirmed the past findings of syntactic priming, with active/passive priming. As well as two Japanese studies, Experiment 5 in English (with the same materials) also demonstrated a syntactic priming effect with actives/passives. Thus this is the first reported evidence that syntactic priming occurs in Japanese.

However, while Bock et al. (1992) demonstrated an animacy-binding effect, where there was a tendency to bind particular animacy features to particular grammatical functions, none of the Experiments in Japanese showed any animacy-binding effects. Experiment 5 in English confirmed that the lack of such difference was not due to the difference in language.

As it was discussed in 4.10, it is important to note that the definitions of the animacy effect (Experiment 1 and 2) and the animacy-binding effect (Experiment 3, 4 and 5) are different – while the animacy effect means that people would always produce OSV or passive sentences when they have inanimate subjects irrespective of the prime sentence, the animacy-binding effect means that there would be priming effect that people would produce OSVs or passives (i.e., animate-first) more after hearing an animate-first prime sentence than inanimate-first prime sentence. Thus the lack of the animacy-binding effect does not mean that animacy has no influence on the choice of grammatical encoding.

Now we need to consider why the two Japanese studies failed to demonstrate the animacy-binding effect. It is possible to consider the difference of languages as the reason behind the lack of animacy-binding effect. Since Experiments 3 and 4 adopted Japanese and Bock et al. (1992) conducted their Experiment in English, such a difference could have caused the different results regarding the animacy-binding effect. In order to solve this issue, Experiment 5 was carried out in English with the same materials and methodology as Experiments 3 and 4. Since the results of Experiment 5 were identical to those of the two Japanese studies, we can reject the idea that the lack of animacy-binding effect was due to the difference in languages.

One alternative idea is that this difference could be due to the slight difference in methodologies. While Bock et al. (1992) used a production-to-production methodology (where participants read out prime sentences and described target pictures), the three Experiments in this thesis used a method from comprehension to production (speakers read prime sentences silently and described target pictures orally). Although many studies have confirmed that syntactic priming occurs from comprehension to production (e.g., Branigan et al., 2000), the slight difference between these two methodologies may have caused the differences reported here. I will leave this question for further research.

We will now consider at what stage the two priming effects occur during language production. Empirical studies have suggested that, for example, the animacy binding effect occurs at the conceptual level, and the syntactic priming effect at the functional level (Bock et al., 1992). However, since the two Japanese studies found word order priming and voice priming, but not an animacy-binding effect, this rejects the idea of conceptual priming.

Firstly, it seems plausible that the results of the current studies may be explained under the current

models of language production (e.g., Bock and Levelt, 1994; Garrett, 1980). To recall, I discussed in chapter 2 that existing models of grammatical encoding suggest that functional processing takes place directly after message generation, then positional processing takes place subsequently. However, Kempen and Harbusch (2004) suggested that such a model cannot explain why animacy directly influences the choice of word order, and they furthermore claimed that there should be a more flexible grammatical encoding structure that can explain the results of Kempen and Harbusch's study. In fact, the results of the sentence recall studies in Japanese (chapter 3) showed that animacy influences not only word order (SOV/OSV in Experiment 1), but also simultaneously both grammatical role assignment (active/passive) and word order. Thus under the current models of grammatical encoding, it can be interpreted that animacy would influence both the functional level (grammatical function assignment) and the positional level (word order variation). However, as Kempen and Harbusch (2004) and Branigan et al. (2008) noted, it seems such a model may be 'unparsimonious'.

Therefore, Branigan et al. (2008) suggest that in an alternative model, grammatical functions and word order are determined during a single stage of processing, with entities being assigned a grammatical function and a word order position simultaneously. Conceptually more accessible entities (e.g., animate) seem to be retrieved earlier than conceptually less accessible entities (e.g., inanimate). Thus animate entities would tend to be assigned in both higher grammatical functions and earlier word order positions than inanimate entities. Thus, this may suggest that it is possible to have a different architecture for grammatical encoding, where both grammatical role and serial order assignments in grammatical encoding would be formulated at one single stage.

Branigan et al. (2008) furthermore suggest that such a view is compatible with an extended model of lexico-syntactic representation proposed by Pickering and Branigan (1998). In chapter 2 (section 2.1.1), I

discussed the theory of lexical access in production, developed by Levelt et al. (1999). To recall, Levelt et al. (1999) proposed that a conceptual representation for a word is linked to a lemma representation and a word-form representation. The lemma contains an abstract representation which specifies syntactic information (e.g., grammatical gender or class).

Pickering and Branigan furthermore claimed that grammatical information is represented at the lemma stratum and certain words are linked to combinatorial information in lemmas. For example, the lemma for *give* would be linked to a combinatorial node associated with the prepositional object (PO) construction (*give the book to the boy*) and a combinatorial node associated with the double object (DO) construction (*give the boy the book*). When people produce one of these constructions, they activate both the lemma and the relevant combinatorial node. Such a model is compatible with the finding that people tend to repeat syntactic structures (syntactic priming; Bock, 1986a; Bock et al., 1992), and that this tendency is stronger when the verb is repeated across sentences (Branigan et al., 2000; Pickering and Branigan, 1998). In Pickering and Branigan's model, this syntactic priming effect is explained in terms of residual activation of a combinatorial node, and lexical enhancement is explained in terms of strengthening of the link between a combinatorial node and a particular verb lemma.

Branigan et al. (2008) furthermore suggests an extended model of the lemma stratum, as in Figure 21, where word order and grammatical function assignment are differentiated. Branigan et al. (2008) assume that when people access a verb lemma, they also access the combinatorial nodes of the voice (which is associated with grammatical function assignment) and the constituent structure (which specifies constituent structure such as word order). Such a model is consistent with the view that, from the results of the current studies, Japanese speakers make a one-stage choice between SOV-active and SOV-passive, OSV-active and OSV-passive.

Empirical studies about syntactic priming effect confirm the verb lemma with a voice node and a combinatorial node of constituent structure. Pickering, Branigan and McLean (2002) found that people tended to repeat the PO form when they had just produced a PO form with the constituents in the same order (*The racing driver showed the extremely dirty and badly torn overall to the mechanic*) but not when they had just produced a heavy-shifted PO (*The racing driver showed to the mechanic the extremely dirty and badly torn overall*). This suggests that there is no tendency to repeat constituents without also repeating their orders and therefore there are separate combinatorial nodes corresponding to constituent structures that differ in word order alone. Additionally, Hartsuiker, Pickering and Veltkamp (2004) found the priming effect from active to active, and from passive to passive (in their case, priming between Spanish and English). Such a result in turn supports the existence of active and passive node linked to the relevant lemma. Such nodes of course differ in two respects: the range of grammatical functions with which they are associated (active with subject and direct object; passive with subject and oblique object), and the linking of those roles with particular event roles (e.g., active subject with agent, passive subject with patient). These suggest the existence of the combinatorial nodes of a voice and a constituent structure, and such a processing is formulated in one stage, and such a view is compatible with the results of the current studies.

Note that these combinatorial nodes are not combined ones, such as subject-first active, subject-first passive, object-first active and object-first passive. If such nodes are combined, for instance, subject-first passive would only prime subject-first passive (but it would not prime object-first passive at all). However that is not consistent with the current finding (participants did produce object-first passive after the subject-first passive prime).

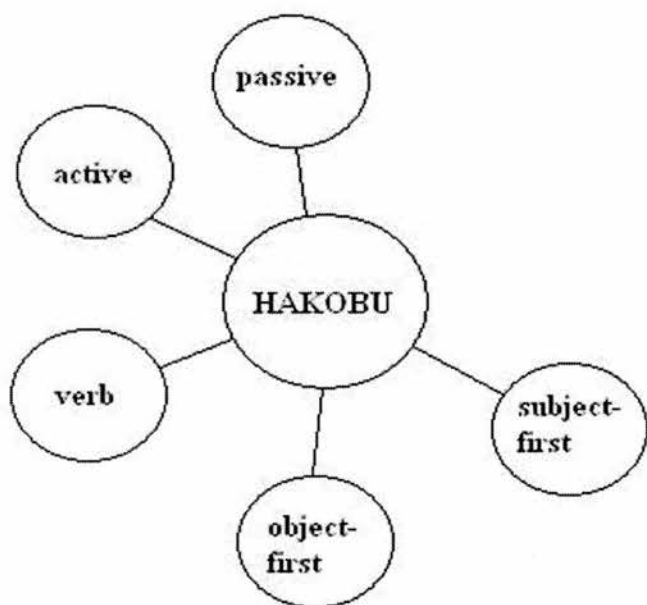


Fig. 21. Fragment of the lemma stratum linked to voice and word order information associated with 'HAKOBU' (to carry) in Japanese. (from Branigan et al., 2008)

4.15. Summary

Taken together, from the results of the three Experiments, several conclusions can be drawn under the current models of language production (Bock & Levelt, 1994; Garrett, 1980). The three Experiments in Japanese and English investigated syntactic repetition and the influence of animacy on Japanese word orders (SOV/OSV) and Japanese/English voices (active/passive), using a picture description technique (e.g., Bock et al., 1992). Across all three Experiments, the syntactic priming effect was confirmed; speakers were more likely to describe pictures with the same syntactic structure they had just heard. However these Experiments also confirmed the lack of an animacy-binding effect, in contrast to Bock et al.'s (1992) finding. Thus, these findings reject the earlier claim that there was no tendency to bind or place particular animacy features to particular grammatical functions or word order positions. Thus, such results can be explained by the residual activation of the lemma stratum proposed by Pickering and Branigan (1998) and

Branigan et al. (2008). It suggests that the combinatorial nodes of the lemma are linked to the grammatical function assignment (voice) and constituent structure (word order). Such a view is consistent with the findings in Chapter 3's recall tasks in Japanese, that animacy influences the choice of grammatical function assignment and word order simultaneously.

Chapter 5 Conclusion

5.1. Summary of the current study

This thesis investigates the details of the processing and representation of conceptual and syntactic information in language production. I carried out two types of psycholinguistic experiments in Japanese and English: sentence recall tasks (e.g., Bock & Warren, 1985; McDonald et al., 1993), and syntactic priming tasks (e.g. Bock, 1986b; Bock et al., 1992; Pickering & Branigan, 1998). A number of conclusions can be drawn from the results of the 5 experiments presented in this thesis.

The two experiments presented in chapter 3 assessed the influence of animacy on syntactic processing in language production. Using a sentence recall task (e.g., Bock & Warren, 1985), the experiments demonstrated an effect of conceptual accessibility on grammatical function assignment and serial word order in Japanese.

In Experiment 1, I examined the effect of animacy on two different word orders (SOV and OSV) and NP conjunctions in Japanese. The results of Experiment 1 showed that, firstly, SOV is a preferred word order and participants did not invert the SOV word order, irrespective of animacy. Secondly, more importantly, word order variation in Japanese OSV sentences was strongly affected by animacy. Participants produced more word order inversions in OSV sentences when this inversion resulted in an animate entity being in first position. This result strongly suggests that conceptual accessibility affects word order.

However, as in Bock and Warren (1985), in which the authors failed to find any tendency for

participants to produce animate nouns earlier than inanimate ones in NP conjunctions, the results of Experiment 1 showed no effect of animacy on two conjuncts in Japanese. Thus the processing of NP conjunctions may be rather complex (e.g., Chomsky, 1957) and may be different from processing in normal declarative sentences (Branigan & Feleki, 1999).

Experiment 2 investigated the effect of conceptual accessibility on both grammatical function assignment (active-passive) and word order (SOV-OSV). The results of Experiment 2 confirmed that, first of all, as Experiment 1 showed, SOV is generally a preferred word order, therefore participants did not invert the SOV word order, irrespective of animacy and voice structure. Secondly, when OSV orders were presented, participants tended to produce alternative word orders (SOV). In particular, OSV sentences with conceptually less accessible nouns (inanimate NPs) in object position were produced more often as SOV sentences than as OSV sentences with animate nouns in subject function, irrespective of voice. Thirdly, following Bock and Warren (1985) and McDonald et al. (1993), grammatical function assignment was influenced by animacy variation. When animate nouns were not assigned the subject function, active/passive sentences were recalled as passive/active, so that the animate noun became the subject, irrespective of word order in Japanese (SOV/OSV).

Therefore, two sentence recall experiments in Japanese showed a role of conceptual accessibility in determining grammatical function assignment (such as active and passive), and word order (such as SOV or OSV). I interpret these results as evidence that conceptual accessibility influences the production of Japanese, and this suggests highly incremental processing (e.g., Levelt, 1989).

The three Experiments I presented in chapter 4 investigated the syntactic priming effect and the influence of animacy on Japanese word order (SOV/OSV) and Japanese/English voice (active/passive).

Bock et al. (1992) adopted a picture description task (comprehension-to-production task) and found a syntactic priming effect on active/passive structures in English: participants were more likely to describe target pictures with passives after producing passives than actives. Using a picture description technique (production-to-production task), all three Experiments confirmed the syntactic priming effect; Japanese speakers were more likely to describe target pictures with SOV sentences after SOV primes than after OSV primes, or with OSV sentences after OSV prime sentences than after SOV sentences (Experiment 3); Japanese and English speakers were also more likely to describe target pictures with active sentences after active primes than passive primes, or with passive sentences after passive primes than active primes (Experiments 4 and 5).

In addition to this, Bock et al. (1992) also found an animacy binding effect: there was a tendency to bind particular animacy features to particular grammatical functions (subject or object). As a result, participants were more likely to describe a target picture with an inanimate subject than an animate subject after they had read a sentence with an inanimate subject. However, their claim could also be interpreted as a tendency to place a particular animacy in a particular position (early in the sentence or late in the sentence). Thus Experiment 3 investigated the effect of animacy binding on word order, and Experiment 4 examined its effect on grammatical functions. In contrast to Bock et al.'s (1992) finding, the 3 experiments presented in Chapter 4 confirmed the lack of an animacy-binding effect. In other words, there was no tendency for speakers to bind particular animacy features to particular grammatical functions (Experiment 4) or word order positions (Experiment 3). Experiment 5 in English was identical to Experiment 4 in Japanese and it showed exactly the same result, suggesting that the lack of an animacy-binding effect was not due to the differences between Japanese and English.

It is important to note that, since the definitions of the animacy effect (Experiment 1 and 2) and the

animacy-binding effect (Experiment 3, 4 and 5) are different, the lack of animacy-binding effect does not mean that animacy does not influence the choice of grammatical encoding. The animacy effect means that people would always produce OSV or passive sentences when they have inanimate subjects irrespective of the prime sentence. In contrast, the animacy-binding effect (Experiment 3, 4 and 5) means that people would produce OSVs or passives (i.e., animate-first) more after hearing an animate-first prime sentence than inanimate-first prime sentence. Thus such a difference suggests that the lack of the animacy-binding effect does not mean that animacy does not influence the choice of grammatical encoding.

Based on the pattern of results observed throughout these 5 psycholinguistic experiments in Japanese and English, it appears that grammatical functions and word order are determined during a single stage of processing, with entities being assigned a grammatical function and a word order position simultaneously. The results are compatible with conceptually more accessible entities (e.g., animate) being retrieved earlier than conceptually less accessible entities (e.g., inanimate), and hence animate entities tending to be assigned both higher grammatical functions and earlier word order positions than inanimate entities.

Such a view is compatible with an extended model of lexico-syntactic representation proposed by Pickering and Branigan (1998) and Branigan et al. (2008). Levelt et al. (1999) proposed the theory of lexical access in production, where a conceptual representation for a word is linked to a lemma representation and a word-form representation. The lemma contains an abstract representation which specifies syntactic information (e.g., grammatical gender or class). Pickering and Branigan furthermore claimed that grammatical information is represented at the lemma stratum, and certain words are linked to combinatorial information in lemmas. For example, the lemma for *give* would be linked to a combinatorial node associated with the prepositional object (PO) construction and a combinatorial node associated with the double object (DO) construction. When people produce a syntactic structure, they activate both the

lemma and the relevant combinatorial node. Such a model is compatible with the finding that people tend to repeat syntactic structures (Bock, 1986a, Bock et al, 1992), and that this tendency is stronger when the verb is repeated across sentences (Branigan et al., 2000; Pickering & Branigan, 1998).

Branigan et al. furthermore suggest an extended model of the lemma stratum, where word order and grammatical function assignment are differentiated. Branigan et al. assume that when people access a verb lemma, they also access the combinatorial nodes of the voice (which is associated with grammatical function assignment) and the constituent structure (which specifies constituent structure such as word order). Such a model is consistent with the finding of the three priming experiments in chapter 4: that a syntactic priming effect occurs for Japanese word orders (Experiment 3) and Japanese/English voice (Experiment 4 and 5).

Such an extended lemma model is supported by some empirical studies. Pickering et al. (2002) found that although speakers tended to repeat the PO forms after producing the PO prime forms, they did not tend to repeat the heavy-shifted PO form (*The racing driver showed to the mechanic the extremely dirty and badly torn overall*) when they had just produced it. This suggests that there is no tendency to repeat constituents without also repeating their orders. In another study, Hartsuiker et al. (2004) found the priming effect from active to active, and from passive to passive (in their case, priming between Spanish and English). Thus both studies confirmed the combinatorial nodes of the relevant lemma, corresponding constituent structures (Pickering et al., 2002) and grammatical functions (active and passives, Hartsuiker et al., 2004), and these are consistent with the results of the two recall experiments in chapter 3, which support the hypothesis that grammatical encoding is formulated in one stage. This means that Japanese speakers make a one-stage choice between SOV-active and SOV-passive, OSV-active and OSV-passive.

Such a model could be supported by grammatical theory such as HPSG (Gazdar et al., 1985; Pollard & Sag, 1987: 1994). The theory of an HPSG grammar separates hierarchical (Immediate dominance) and linear structure (Linear precedence). It is assumed that immediate dominance schemata license constituent structure and linear precedence statements constrain constituent order. Such a variation would reflect the different nodes of the lemma model: dominance represents grammatical function assignment such as active or passive and linear precedence represents word order variation such as subject-first or object-first, therefore such a theory would fit the findings of the current study. In addition to this, since HPSG is a non-transformational grammar, it would be easily amenable to incremental production (e.g., Kempen & Harbusch, 2002)

Note that it is also possible to suggest that the results of the current studies may be explained under the current models of language production (e.g., Bock and Levelt, 1994; Garrett, 1980). The existing models of grammatical encoding suggest that functional processing takes place directly after message generation, then positional processing takes place subsequently. However, the results of the sentence recall studies in Japanese (chapter 3) showed that animacy influences not only word order (SOV/OSV in Experiment 1), but also simultaneously both grammatical role assignment (active/passive) and word order (Experiment 2). Thus under the current models of grammatical encoding, it can be interpreted that animacy would influence two separate levels of processing: the functional level (grammatical function assignment) and the positional level (word order variation). In this sense, animacy would influence the process of grammatical function assignment and subsequently influence the choice of word order. However, Kempen and Harbusch (2004) and Branigan et al. (2008) suggest that it seems such a model may be unparsimonious and it may not be compatible with the results of the current study.

5.2. Further research

There also remain a number of unanswered questions regarding the current study. There are three aspects of this. First of all, it has to be clarified what causes producing different syntactic structure, in particular, different word orders (SOV and OSV) in Japanese. The current study showed that animacy or syntactic priming could be the factors to influence the choice of different word orders. However, there have not been any studies working on the precise nature of the meaning of different word orders in Japanese (e.g., the semantic difference between SOV and OSV), particularly in language production. For instance, it has been suggested that ‘focus’ causes the motivation of producing OSV orders, placing the object first to express the word that a speaker wants to focus (Yamashita, 2002) or speakers tend to produce ‘given’ arguments before ‘new’ arguments (‘givenness’, Ferreira & Yoshita, 2003). An experimental study by Yamashita and Chang (2001) showed the ‘short-before-long’, that while there was a tendency for speakers to correctly recall sentences involving shorter phrase, they tended to place longer phrase earlier. Thus such a difference may influence the choice of word order. However, other aspects of word order change or the motivation of producing word order remain unclear, particularly in language production. Further study should be carried out to investigate the precise nature of producing different word orders in Japanese.

The second point is the methodology. In Experiment 1 and 2, I presented the effect of animacy on syntactic structure by using the sentence recall methodology. Although recall paradigms can simulate the natural processes of production (as claimed by Potter & Lombardi, 1990; Bock, 1996), it is plausible that this type of task may not represent the natural process of production. For instance, since this type of task is memory-based, there are some concerns that some lexical items may be temporally more accessible than others and they may be retrieved faster during recall. Or it may also be possible that participants tend to remember the form of certain types of sentences better than others (e.g., passives more than actives). From

the current study, it is not possible to solve these issues. Further studies should be carried out to investigate the relationship between memory and conceptual accessibility.

Related to this, it is necessary to investigate why I failed to get the animacy-binding effect in all three experiments in chapter 4. There was a difference between the current study and Bock et al. (1992) in terms of the animacy-binding effect. Three experiments conducted in Japanese and English (Experiment 3, 4 and 5) constantly failed to demonstrate the animacy-binding effect. It is possible that this difference could be due to the slight difference in methodologies. While Bock et al. (1992) used a production-to-production methodology (where participants read out prime sentences and described target pictures), the three Experiments in this thesis used a method from comprehension to production (speakers read prime sentences silently and described target pictures orally). Although many studies have confirmed that syntactic priming occurs from comprehension to production (e.g., Branigan et al., 2000a), the slight difference between these two methodologies between the current study and Bock et al. (1992) may have caused the differences reported here. Further studies should be carried out using the same production-to-production task (Bock et al., 1992) or dialogue task (e.g., Branigan et al., 2000a) to further study the animacy-binding effect on different grammatical functions and word order in Japanese and English.

Finally, I argue that the finding that word order and grammatical function assignment are differentiated at the lemma stratum is compatible with an extended model of the lemma stratum (Branigan et al., 2008). However, this model has been proposed solely by the results of the current Japanese study. Further studies should be carried out in order to investigate this model furthermore. In particular, it would be interesting to see if this model can be extended to other free word order languages, such as German or Greek. It is also possible to carry out the experiments to bilingual speakers to investigate this lemma model. The empirical studies found the syntactic priming effect between different languages (e.g., Hartsuiker et al., 2004).

However, their claim comes from the two languages using similar grammatical forms to each other (in Spanish (first language)-English (second language) bilinguals) under very similar conditions, such that the languages are highly related. Thus it would be interesting to see if this syntactic priming effect would occur when the two languages are less closely related and different constructions are used, such as Japanese and English.

5.3. Conclusion

In conclusion, I have explored new areas of language production research. The main issue of this thesis is the investigation of the processing mechanisms of language production. In particular, it explores the detailed process of how conceptual information is transformed into grammatical information in production. Through out the thesis, the current study examined how psycholinguistic experiments on ‘animacy’ can help us to determine the structure of grammatical encoding. The 5 psycholinguistic experiments that I conducted showed that grammatical functions and word order are determined during a single stage of processing, with entities being assigned a grammatical function and a word order position simultaneously. Such a finding is compatible with an extended lemma model (Branigan et al., 2008; Pickering & Branigan, 1998), where word order and grammatical function assignment are differentiated at the lemma stratum and they can be formulated at one stage. In addition, it notes that such studies show some interesting comparisons between English and Japanese, reinforcing the importance of a cross-linguistic perspective in psycholinguistic research. This makes it possible to examine the cross-linguistic applicability of our models of language production, with particular reference to the production of different syntactic structures and word order.

References

- Aissen, J. (2003). Differential Object Marking: iconicity vs. economy. *Natural Language and Linguistic Theory*, 21, 435-483.
- Anderson, J. R., & Paulson, R. (1977). Representation and retention of verbatim information. *Journal of Verbal Learning and Verbal Behavior*, 16, 439-445.
- Badecker, W., Miozzo, M., & Zanuttini, R. (1995). The dissociation of form-based lexical retrieval from access to word-specific aspects of grammar: Evidence for two-stage lexical processing. *Cognition*, 57, 193-216.
- Bates, E., & Devescovi, A. (1989). A cross-linguistic approach to sentence production. In B. MacWhinney & E. Bates (Eds.), *The Crosslinguistic study of sentence processing*. (pp.225-256) New York: Cambridge University Press.
- Beattie, G., & Butterworth, B. (1979). Contextual probability and word frequency as determinants of pauses and errors in spontaneous speech. *Language and Speech*, 22, 201-211.
- Bock, J. K. (1977). The Effect of a Pragmatic Presupposition on Syntactic Structure in Question Answering. *Journal of Verbal Learning and Verbal Behavior*, 16, 723-734.
- Bock, J. K. (1982). Toward a cognitive psychology of syntax: Information processing contributions to sentence formulation. *Psychological Review*, 89, 1-47.
- Bock, J. K. (1986a). Meaning, sound, and syntax: Lexical priming in sentence production. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 12, 575-586.
- Bock, J. K. (1986b). Syntactic Persistence in Language Production. *Cognitive Psychology*, 18, 355-387.
- Bock, J.K. (1987a). An effect of the accessibility of word-forms on sentence structures. *Journal of Memory and Language*, 26, 119-137.
- Bock, J. K. (1987b). Co-ordinating Words and Syntax in Speech Plans. In A. W. Ellis (Ed), *Progress in the Psychology of Language*, Vol. 3, (pp.337-389). London: Lawrence Erlbaum.

- Bock, J. K. (1989). Closed-class immanence in sentence production. *Cognition*, 31, 163-186.
- Bock, J. K. (1995). Sentence production: From mind to mouth. In J. L. Miller & P. D. Eimas (Eds.), *Handbook of perception and cognition: Speech, language and communication* Vol. 11, (pp.181-216). Orlando, FL: Academic Press.
- Bock, J. K. (1996). Language production: Methods and methodologies. *Psychonomic Bulletin & Review*, 3, 395-421.
- Bock, J. K. & Cutting, C. (1992). Regulating Mental Energy: Performance Units in Language Production. *Journal of Memory and Language*, 31, 99-127.
- Bock, J. K., & Griffin, Z. M. (2000). The persistence of structural priming: Transient activation or implicit learning? *Journal of Experimental Psychology: General*, 129, 177-192.
- Bock, J. K. & Irwin, D. E. (1980). Syntactic Effects of Information Availability in Sentence Production. *Journal of Verbal Learning and Verbal Behaviour*, 19, 467-484.
- Bock, J. K., & Kroch, A. S. (1989). The isolability of syntactic processing. In G. N. Carlson, & M. K. Tanenhaus (Ed.), *Linguistic structure in language processing* (pp. 157-196). Dordrecht: Kluwer.
- Bock, J. K., & Loebell, H. (1990). Framing sentences. *Cognition*, 35, 1-39.
- Bock, J. K., & Levelt, W. (1994). Language production: Grammatical encoding. In Gernsbacher, Morton Ann (Ed). (1994), *Handbook of Psycholinguistics* (pp. 945-984). San Diego, CA, US: Academic Press, Inc.
- Bock, J.K., & Warren. R. (1985). Conceptual accessibility and syntactic structure in sentence formulation. *Cognition*, 21, 47-67.
- Bock, J.K., Loebell, H., Morey, R. (1992). From conceptual roles to structural relations: bridging the syntactic cleft. *Psychological Review*, 99, 150-171.
- Boomer, D. S. (1965) Hesitation and grammatical encoding, *Language and Speech*, 8, 148-158.
- Branigan, H. (1995). *Language Processing and the Mental Representation of Syntactic Structure*. Ph.D.

thesis, Centre for Cognitive Science, The University of Edinburgh.

Branigan, H.P. & Feleki, E. (1999). Conceptual accessibility and serial order in Greek speech production. *Proceedings of the 21st Cognitive Science Society Conference*, Vancouver.

Branigan, H.P., Pickering, M.J. & Cleland, A.A.. (1999). Syntactic priming in written production: Evidence for rapid decay. *Psychonomic Bulletin & Review*, 6, 535-540.

Branigan, H.P., Pickering, M.J. & Cleland, A.A. (2000a). Syntactic coordination in dialogue. *Cognition*, 75, B13-B25.

Branigan, H.P., Pickering, M.J. & Tanaka, M. (2008). Contributions of animacy to grammatical function assignment and word order during production. *Lingua*, 118, 172-189.

Branigan, H.P., Pickering, M.J., Stewart, A.J. & McLean, J.F. (2000b). Syntactic priming in spoken production: Linguistic and temporal interference. *Memory & Cognition*, 28, 1297-1302.

Brown, R. & McNeill, D. (1966). The 'tip of the tongue' phenomenon. *Journal of Verbal Learning and Verbal Behaviour*, 5, 325-337.

Buckingham, H. W. (1979). Linguistic aspects of lexical retrieval disturbances in the posterior fluent aphasia. In H. Whitaker and H. A. Whitaker (Eds.), *Studies in Neurolinguistics*, volume 4, chapter 7, (pp.269-291). New York: Academic.

Butterworth, B. (1982). Speech errors: Old data in search of new theories. In A. Cutler (Ed.), *Slips of the tongue and language production*. (pp.73-108). Berlin: Mouton.

Butterworth, B. (1989). Lexical access in speech production. In W. Marslen-Wilson (Ed.), *Lexical representation and process* (pp.103-135). Cambridge, MA: MIT Press.

Butterworth, B. L., & Beattie, G. W. (1978). Gesture and silence as indicators of planning in speech. In R. N. Campbell, & P.T. Smith (Eds.), *Recent advances in the psychology of language: Formal and experimental approaches*. (pp.347-360) New York: Plenum.

Byrne, B. & Davidson, E. (1985). On putting the horse before the cart: Exploring conceptual bases of word order via acquisition of a miniature artificial language. *Journal of Memory and Language*, 24,

377-389.

- Caramazza, A., & Miozzo, M. (1997). The relation between syntactic and phonological knowledge in lexical access: Evidence from the “tip-of-the-tongue” phenomenon. *Cognition*, 64, 309-343.
- Carroll, J. B. (1958). Communication theory, linguistics, and psycholinguistics. *Review of Educational Research*, 28, 79-88.
- Chang, F., Bock, K., & Goldberg, A. E. (2003). Can thematic roles leave traces of their places? *Cognition*, 90, 29-49.
- Chang, F., Dell, G. S., & Bock, J. K. (2006). Becoming syntactic. *Psychological Review*, 113, 234-272.
- Chang, F., Dell, G. S., Bock, J. K., & Griffin, Z. M. (2000). Structural priming as implicit learning: A comparison of models of sentence production. *Journal of Psycholinguistic Research*, 29, 217-229.
- Chomsky, N. (1957). *Syntactic Structures*. The Hague. Mouton.
- Chomsky, N. (1981). *Lectures on Government and Binding*. Dordrecht: Foris Publications .
- Christianson, K., & Ferreira, F. (2005). Conceptual accessibility and sentence production in a free word order language (Odawa). *Cognition*, 98, 105-135.
- Clark, H. H. (1965). Some Structural Properties of Simple Active and Passive Sentences. *Journal of Verbal Learning and Verbal Behaviour*, 4, 375-370.
- Clark, H. H. & Begun, J. S. (1971). The Semantics of Sentence Subjects. *Language and Speech*, 14, 34-46.
- Cleland, A. (2003). *The syntactic representation and processing of nouns and verbs in language production*. Ph.D. thesis, Department of Psychology, The University of Edinburgh.
- Comrie, B. (1989). *Language Universals and Linguistic Typology*. Chicago, IL: University of Chicago Press.
- Cooper, W. E., Paccia, J. M., & Lapointe, S. G. (1978). Hierarchical coding in speech timing. *Cognitive Psychology*, 10, 154-177.

- Cooper, W.E. & Ross, J.R. (1975). World order. In R.E. Grossmann, L.J. San, and T.J. Vance (Eds). *Papers from the parasession on functionalism*. Chicago Linguistic Society.
- Cuetos, F., & Mitchell, D. C. (1988). Cross-linguistic differences in parsing: restrictions on the issue of the late closure strategy in Spanish. *Cognition*, 30, 73–105.
- Cutler, A. (1982). The reliability of speech error data. In A. Cutler, editor, *Slips of the Tongue and Language Production* (pp.7–28). Mouton.
- Cutler, A. (1988). The perfect speech error. In L. M. Hyman & C. S. Li (Eds.), *Language, speech and mind: Studies in honour of Victoria A. Fromkin* (pp. 209-223). London: Routledge.
- Cutting, J. C., & Ferreira, V. S. (1999). Semantic and phonological information flow in the production lexicon. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 25, 318–344.
- Damian, M. F., & Martin, R. C. (1999). Semantic and phonological codes interact in single word production. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 25, 345-361.
- Deane, P. D. (1987). English possessives, topicality, and the Silverstein hierarchy. *Proceedings of the Annual Meeting of the Berkeley Linguistics Society*. 13, 65-76.
- De Smedt, K. (1990). IPF: An incremental parallel formulator. In R. Dale, C. Mellish, & M. Zock(Eds.), *Current research in natural language generation* (pp.167-192). London: Academic Press.
- De Smedt, K. (1994). Parallelism in incremental sentence generation. In Adriaens, Geert; Hahn, Udo (Eds.), *Parallel natural language processing* (pp. 421-447). Norwood, NJ: Ablex.
- De Smedt, K. (1996). Computational models of incremental grammatical encoding. In T. Dijkstra and K. De Smedt (Eds.), *Computational Psycholinguistics* (pp. 279-307). London: Taylor & Francis.
- De Smedt, K. J. & Kempen, G. (1987). Incremental sentence production, self-correction and coordination. In G. Kempen (Ed.), *Natural Language Generation: News Results in Artificial Intelligence, Psychology and Linguistics*, chapter 23, (pp.365-376). Dordrecht.
- De Smedt, K., & Kempen, G. (1991). Segment Grammar: A formalism for incremental sentence generation. In C. L. Paris, W. R. Swartout & W. C. Mann (Eds.), *Natural language generation in artificial*

intelligence and computational linguistics (pp. 329–349). Boston: Kluwer Academic Publishers.

del Viso, S., Igoa, J. M. & García-Albea, J. E. (1991). On the autonomy of phonological encoding: evidence from slips of the tongue in Spanish. *Journal of Psycholinguistic Research*, 20(3), 161–185.

Dell, G. S. (1986). A Spreading-activation Theory of Retrieval in Sentence Production. *Psychological Review*, 93(3), 283–321.

Dell, G. S. & O'Seaghdha, P. G. (1991). Mediated and Convergent Lexical Priming in Language Production: A Comment on Levelt et al. (1991). *Psychological Review*, 4, 604–614.

Dell, G. S. & O'Seaghdha, P. G. (1992). Stages of lexical access in language production. *Cognition*, 42, 287–314.

Dell, G. S. & Reich, P. A. (1981). Stages in Sentence Production: An Analysis of Speech Error Data. *Journal of Verbal Learning and Verbal Behaviour*, 20, 611–629.

Desmet, T. & Declercq M. (2006). Cross-linguistic priming of syntactic hierarchical configuration information. *Journal of Memory and Language*, 54, 610–32.

Enel, S. (1977). Where do the subjects of sentences come from? In S. Rosenherg (Ed.), *Sentence Production: Developments in Research and Theory* (pp.141-167). Hillsdale, NJ: Erlbaum.

Estival, D. (1985). Syntactic priming of the passive in English. *Text*, 5, 7-21.

Fay, D. & Cutler, A. (1977). Malapropisms and the Structure of the Mental Lexicon. *Linguistic Inquiry*, 8, 505-520.

Ferreira, F. (1994). Choice of passive voice is affected by verb type and animacy. *Journal of Memory and Language*, 33, 715–736.

Ferreira, V.S. (1996). Is it better to give than to donate? Syntactic flexibility in language production. *Journal of Memory and Language*, 35, 724-755.

Ferreira, V. S. (2003). The persistence of optional complementizer production: Why saying "that" is not

saying "that" at all. *Journal of Memory and Language*, 48, 379-398.

- Ferreira, V. S., & Bock, J.K. (2006). The functions of structural priming. *Language and Cognitive Processes*, 21, 1011-29.
- Ferreira, V. S. & Dell, G. S. (2000). The effect of ambiguity and lexical availability on syntactic and lexical production. *Cognitive Psychology*, 40, 296-340.
- Ferreira, V. S., & Yoshita, H. (2003). Given-New Ordering Effects on the Production of Scrambled Sentences in Japanese. *Journal of Psycholinguistic Research*, 32, 669-692.
- Flores-d'Arcais, G. B. (1987). Perceptual Factors and Word Order in Event Descriptions. In G. Kempen, editor, *Natural Language Generation*, chapter 28, (pp.441-451). Dordrecht.
- Ford, M. (1993). Characteristics of Hesitation Phenomena. In G. Blanken, J. Dittmann, H. Grimm, J. C. Marshall, and C. W. Wallesch, editors, *Linguistic Disorders and Pathologies* (pp.46-52). Walter de Gruyter.
- Fox Tree, J. E., & Meijer, P. J. A. (1999). Building syntactic structure in speaking. *Journal of Psycholinguistic Research*, 28, 71-92.
- Fromkin, V.A. (1971). The non-anomalous nature of anomalous utterances. *Language*, 47, 27-52
- Fromkin, V. A. (1973). *Speech errors as linguistic evidence*. The Hague: Mouton.
- Gair, J. (1970). *Colloquial Sinhalese Clause Structures*, The Hague. Mouton.
- Garcia-Albea, J. E., del Viso, S., & Igoa, J. M. (1989). Movement Errors and Levels of Processing in Sentence Production. *Journal of Psycholinguistic Research*, 18, 145 161.
- Garnham, A., Shillcock, R. C., Brown, G. D., Mill, A. I., & Cutler, A. (1982). Slips of the tongue in the London-Lund corpus of spontaneous conversation. In A. Cutler, editor, *Slips of the Tongue and Language Production* (pp.251-263). Mouton, The Hague.
- Garrett, M. F. (1975). The analysis of sentence production. In Bower, G. (Ed.). *The psychology of learning and motivation: Advances in research and theory*, Vol. 9. New York: Academic Press.

- Garrett, M. F. (1980). Levels of processing in sentence production. In: Butterworth, B. (Ed.), *Language Production, Vol. 1: Speech and Talk*. London: Academic Press.
- Garrett, M. F. (1982). Production of speech: Observations from normal and pathological language use. In A Ellis (Ed.), *Normality and pathology in cognitive functions* (pp. 19-76). London: Academic Press.
- Garrett, M. F. (1988). Processes in language production. In F. J. Newmeyer (Ed.), *Linguistics: The Cambridge survey: III. Language: Psychological and biological aspects* (pp. 69-96). Cambridge: Cambridge University Press.
- Garrett, M.F., (1993). Errors and their relevance for models of language production. In: G. Blanken, J. Dittman, H. Grim, J. Marshall, C. Wallesch (Eds.), *Linguistic Disorders and Pathologies*. de Gruyter, Berlin.
- Gazdar, G., Klein, E., Pullum, G., & Sag, I., (1985). *Generalized Phrase Structure Grammar*. Oxford: Blackwells.
- Goldman-Eisler, F. (1968) *Psycholinguistics: Experiments in spontaneous speech*. London: Academic Press.
- Grieve, R., & Wales, R. (1973). Passives and topicalization. *British Journal of Psychology*, 64, 173-182.
- Griffin, Z. M. & Bock, J.K. (2000). What the eyes say about speaking. *Psychological Science*, 11, 274-279.
- Griffin, Z. M., & Weinstein-Tull, J. (2003). Conceptual structure modulates structural priming in the production of complex sentences. *Journal of Memory & Language*, 49, 537-555.
- Grodzinsky, Y. (2000). The neurology of syntax: Language use without Broca's area. *Behavioral and Brain Sciences*, 23, 1-21.
- Grosjean, F., Grosjean, L., & Lane, H. (1979). The patterns of silence: Performance structures in sentence production. *Cognitive Psychology*, 11, 58-81.
- Halliday, M.A.K. (1970). Language structure and language function. In Lyons, John (Ed.), *New Horizons in Linguistics*. Harmondsworth: Penguin Books.

- Hare, M. L., & Goldberg, A. E. (1999). Structural priming: purely syntactic? In M. Hahn, & S. C. Stoness (Eds.), *Proceedings of the twenty first annual conference of the Cognitive Science Society* (pp. 208-211). Mahwah, NJ: Lawrence Erlbaum Associates.
- Harley, T. A. (1984). A critique of top-down independent levels model of speech production: Evidence from non-plan-internal speech errors. *Cognitive Science*, 8, 191-219.
- Harris, M. (1978). Noun Animacy and the Passive Voice: a Developmental Approach. *Quarterly Journal of Experimental Psychology*, 30, 495-501.
- Hartsuiker, R. J., & Kolk, H. H. J. (1998a). Syntactic persistence in Dutch. *Language and Speech*, 41, 143-184.
- Hartsuiker, R. J., & Kolk, H. H. J. (1998b). Syntactic facilitation in agrammatic sentence production. *Brain and Language*, 62, 221-254.
- Hartsuiker, R. J., & Westenberg, C. (2000). Word order priming in written and spoken sentence production. *Cognition*, 75, B27-B39.
- Hartsuiker, R. J., Kolk, H. H. K., & Huiskamp, P. (1999). Priming word order in sentence production. *Quarterly Journal of Experimental Psychology: Human Experimental Psychology*, 52, 129-147.
- Hartsuiker, R. J., Pickering, M. J., & Veltkamp, E. (2004). Is syntax separate or shared between languages? Cross-linguistic syntactic priming in Spanish/English bilinguals. *Psychological Science*, 15, 409-414.
- Hawkins, J., (1994). *A performance theory of order and constituency*. Cambridge: Cambridge University Press.
- Henaff Gonon, M., Bruckert, R., & Michel, F. (1989). Lexicalization in an anomic patient. *Neuropsychologica*, 27, 391-407.
- Henderson, A., Goldman Eisler, F., & Skarbek, A. (1965). Temporal patterns of cognitive activity and breath control in speech. *Language and Speech*, 8, 236-242
- Heydel, M., & Murray, W. (2000). Conceptual effects in sentence priming: a cross-linguistic perspective.

In M. De Vincenzi, & V. Lombardo (Eds.), *Cross-linguistic perspectives on language processing* (pp.227-255). Dordrecht: Kluwer Academic.

Holmes, V. (1988). Hesitations and Sentence Planning. *Language and Cognitive Processes*, 3, 323-361.

Holmes, V. (1995). A crosslinguistic comparison of the production of utterances in discourse. *Cognition*, 54, 169-207.

Hotopf, W. H. N. (1980). Semantic similarity as a factor in whole-word slips of the tongue. In V. A. Fromkin (Ed.), *Errors in linguistic performance: Slips of the tongue, ear, pen, and hand* (pp. 97-109). New York: Academic Press.

James, C. T., Thompson, J. G., & Baldwin, J. M. (1973). The reconstructive process in sentence memory. *Journal of Verbal Learning and Verbal Behavior*, 12, 51-63.

Jarvella, R. J. (1971). Syntactic processing of connected speech. *Journal of Verbal Learning and Verbal Behavior*, 10, 409-416.

Jescheniak, J. D., & Levelt, W. J. M. (1994). Word frequency effects in speech production: Retrieval of syntactic information and of phonological form. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 20, 824-843.

Johnson, N. F. (1965). The Psychological Reality of Phrase-Structure Rules. *Journal of Verbal Learning and Verbal Behaviour*, 4, 469-475.

Johnson, N. F. (1966a). The Influence of Associations between Elements of Structured Verbal Responses. *Journal of Verbal Learning and Verbal Behaviour*, 5, 369-374.

Johnson, N. F. (1966b). On the Relationship between Sentence Structure and the Latency in Generating the Sentence. *Journal of Verbal Learning and Verbal Behaviour*, 5, 375-380.

Jones, G. V. & Langford, S. (1987). Phonological blocking in the tip of the tongue state. *Cognition*, 26, 115-122.

Kay, J., & Ellis, A. (1987). A cognitive neuropsychological study of anomia. *Brain*, 110, 613-629.

- Keenan, E. L. & Comrie, B. (1977). Noun Phrase Accessibility and Universal Grammar. *Linguistic Inquiry*, 8, 33-99.
- Keil, F.C. (1979). *Semantic and conceptual development: An ontological perspective*. Cambridge, MA: Harvard University Press.
- Kelly, M. H. & Bock, J. K. (1988). Stress in time. *Journal of Experimental Psychology: Human Perception and Performance*, 14, 389-403.
- Kelly, M. H., Bock, J. K., & Keil, F. C. (1986). Prototypicality in a Linguistic Context: Effects on Sentence Structure. *Journal of Memory and Language*, 25, 59-74.
- Kempen, G. (1987). A framework for incremental syntactic tree formation. In: *Proceedings of the Tenth IJCAI*, Milan (pp. 655-660). Los Altos: Morgan Kaufmann.
- Kempen, G & Harbusch, K. (2002). Performance Grammar: A declarative definition. In: Anton Nijholt, Mariët Theune, and Hendri Hondorp (Eds.), *Computational Linguistics in the Netherlands 2001*. Amsterdam: Rodopi.
- Kempen, G & Harbusch, K. (2004). A Corpus study into word order variation in German subordinate clauses: Animacy affects linearization independently of grammatical function assignment. In Pechmann, T (Ed.), *Language Production*. Berlin: Mouton Dr Gruyter.
- Kempen, G. & Hoenkamp, E. (1987). An incremental procedural grammar for sentence formulation. *Cognitive Science*, 11, 201-288.
- Kempen, G. & Huijbers, P. (1983). The lexicalization process in sentence production and naming: Indirect election of words. *Cognition*, 14, 185-209.
- Kuno, S. (1973). *The structure of the Japanese language*. Cambridge, MA: MIT
- Kuno, S. (1976). Subject, theme and speaker's empathy: A reexamination of relativization phenomena. In C. Li (Ed.), *Subject and Topic* (pp.417-444). New York: Academic Press.
- Kuno, S., & Kaburaki, E. (1977). Empathy and syntax. *Linguistic Inquiry*, 8, 627-672.

- Levelt, W.J.M. (1989). *Speaking: From intention to articulation*. Cambridge: MIT Press.
- Levelt, W.J.M. (1999). Models of word production. *Trends in Cognitive Sciences*, 3, 223-229.
- Levelt, W.J.M., & Kempen, G. (1975). Semantic and syntactic aspects of remembering sentences: A review of some recent continental research. In A. Kennedy & A. Wilkes (Eds.), *Studies in long term memory* (pp. 201-215). New York: Wiley.
- Levelt, W. J. M. & Maassen, B. (1981). Lexical search and order of mention in sentence production. In W. Klein and W. Levelt, editors, *Crossing the boundaries in linguistics* (pp.221-252). Dordrecht.
- Levelt, W., & Kelter, S. (1982). Surface form and memory in question answering. *Cognitive Psychology*, 14, 78-106.
- Levelt, W.J.M., Roelofs, A., & Meyer, A.S. (1999). A theory of lexical access in speech production. *Behavioural and Brain Sciences*, 22, 1-38.,
- Levelt, W. J. M., Schriefers, H., Vorberg, D., Meyer, A. S., Pechmann, T., & Havinga, J. (1991a). The Time Course of Lexical Access in Speech Production: A Study of Picture Naming. *Psychological Review*, 98, 122-142.
- Levelt, W. J. M., Schriefers, H., Vorberg, D., Meyer, A. S., Pechmann, T., & Havinga, J. (1991b). Normal and Deviant Lexical Processing: Reply to Dell and O'Seaghdha. *Psychological Review*, 4, 615-618.
- Lindsay, J. R. (1975). Producing Simple Utterances: How Far Ahead Do We Plan? *Cognitive Psychology*, 7, 1-19.
- Loebell, H., & Bock, J. K. (2003). Structural priming across languages. *Linguistics*, 41, 791-824.
- Lombardi, L., & Potter, M. C. (1992). The regeneration of syntax in short term memory. *Journal of Memory and Language*, 31, 713-733.
- MacKay, D. G. (1972). The structure of words and syllables: Evidence from errors in speech. *Cognitive Psychology*, 3, 210-227.

- Mackay, D. G. (1987). *The organization of perception and action: A theory for language and other cognitive skills*. New York: Springer.
- MacLay, H., & Osgood, C. E. (1959). Hesitation phenomena in spontaneous English speech. *Word*, 15, 19-44.
- MacWhinney, B. (1977). Starting points. *Language*, 53, 152-168.
- MacWhinney, B. & Bates, E. (1978). Sentential Devices for Conveying Givenness and Newness: A Cross-Cultural Developmental Study. *Journal of Verbal Learning and Verbal Behaviour*, 17, 539-558.
- McDonald, J., Bock, K., & Kelly, M.H. (1993). Word and world order: Semantic, phonological, and metrical determinants of serial position. *Cognitive Psychology*, 25, 188-230.
- Brown, R., & McNeill, D. (1966). The "tip of the tongue" phenomenon. *Journal of Verbal Learning and Verbal Behavior*, 5, 325-337.
- Meijer, P. J. A., & Fox Tree, J. E. (2003). Building syntactic structures in speaking: a bilingual exploration. *Experimental Psychology*, 50, 184-195.
- Meringer, R., & Meyer, K. (1978). *Versprechen und Verlesen*. Amsterdam: Benjamins. (Original work published 1895)
- Meyer, A. S. & Bock, J. K. (1992). The tip-of-the-tongue phenomenon: Blocking or partial activation? *Memory & Cognition*, 20, 715-726.
- Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review*, 63, 81-97.
- Miozzo, M., & Caramazza, A. (1997). The retrieval of lexical-syntactic features. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 23, 1410-1423.
- Mitchell, D. C., & Cuetos, F. (1991). The origins of parsing strategies. In C. Smith (Ed.), *Current issues in natural language processing*. Austin, TX: Center for Cognitive Science, University of Texas.

- Ortmann, A. (1998). The role of [+animate] in inflection. In: Fabry, R., Ortmann, A., & Parodi, T. (Eds.). *Models of Inflection*, (pp.60-84). Tübingen: Niemeyer.
- Osgood, C. E. (1971). Where do sentences come from? In D. D. Steinberg and L. A. Jakobovits, editors, *Semantics: an interdisciplinary reader in philosophy, linguistics and psychology* (pp.497-529). Cambridge University Press.
- Osgood, C. E., & Bock, J. K. (1977). Salience and sentencing: Some production principles. In S. Rosenberg (Ed.), *Sentence Production: Developments in research and theory* (pp. 89-140). Hillsdale, NJ: Erlbaum.
- Paivio, A. (1971). *Imagery and Verbal Processes*. New York: Holt, Rinehart & Winston.
- Perfect, T. J. & Hanley, J. R. (1992). The tip-of-the-tongue phenomenon: Do experimenter-presented interlopers have any effect? *Cognition*, 45, 55-75.
- Peterson, R. R., & Savoy, P. (1998). Lexical selection and phonological encoding during language production: Evidence for cascaded processing. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 24, 539-557.
- Pickering, M.J. & Branigan, H.P. (1998). The representation of verbs: Evidence from syntactic priming in written production. *Journal of Memory and Language*, 39, 633-655.
- Pickering, M.J., Branigan, H.P., & McLean, J.F. (2002). Constituent structure is formulated in one stage. *Journal of Memory and Language*, 46, 586-605.
- Pickering M.J., & Garrod S. (2004) Toward a Mechanistic Psychology of Dialogue. *Behavioral and Brain Sciences*, 27, 169-225.
- Pollard, C., & Sag, I.A. 1994. *Head-Driven Phrase Structure Grammar*. The University of Chicago Press, Chicago.
- Pollard, C., & Sag, I. A. (1987). Information-based syntax and semantics (Vol. 1). Stanford, CA: CSLI.
- Potter, M. C., & Lombardi, L. (1990). Regeneration in the short-term recall of sentences. *Journal of Memory and Language*, 29, 633-654.

- Potter, M. C., & Lombardi, L. (1998). Syntactic priming in immediate recall of sentences. *Journal of Memory and Language*, 38, 265-282.
- Prat-Sala, M., 1997. *The production of different word orders: A psycholinguistic and developmental approach*. PhD thesis, University of Edinburgh.
- Prat-Sala, M., & Branigan, H. P. (2000). Discourse constraints on syntactic processing in language production: a cross-linguistic study in English and Spanish. *Journal of Memory & Language*, 42, 168-182.
- Press, I. (1986). *A Grammar of Modern Breton*. Berlin: Moton de Gruyter.
- Rosenbach, A. (2005). Animacy versus weight as determinants of grammatical variation in English. *Language*, 81, 613-644.
- Rosenbach, A. (2008). Animacy and grammatical variation – a synthesis. *Lingua*, 118, 151-171
- Roelofs, A. (1992). A spreading-activation theory of lemma retrieval in speaking. *Cognition*, 42, 107-142.
- Roelofs, A. (1993). Testing a non-decompositional theory of lemma retrieval in speaking: Retrieval of verbs. *Cognition*, 47, 59-87.
- Roelofs, A., Meyer, A.S., & Levelt, W.J.M. (1998). A case for the lemma/lexeme distinction in models of speaking: comment on Caramazza and Miozzo (1997). *Cognition*, 69, 219-230.
- Sachs, J. S. (1967). Recognition memory for syntactic and semantic aspects of connected discourse. *Perception and Psychophysics*, 2, 437-442.
- Sachs, J. S. (1974). Memory in reading and listening to discourse. *Memory and Cognition*, 2, 95-100.
- Saffran, E. M., & Martin, N. (1997). Effects of structural priming on sentence production in aphasics. *Language and Cognitive Processes*, 12, 877-882.
- Saffran, E. M., Schwartz, M. F., & Marin, O. S. M. (1980). Evidence from Aphasia: Isolating the Components of a Production Model. In B. Butterworth, editor, *Language Production*, volume 1, chapter 9, (pp.221-241). New York: Academic Press.

- Scheepers, C., (2003). Syntactic priming of relative clause attachments: Persistence of structural configuration in sentence production. *Cognition*, 89, 179-205.
- Schegloff, E., Jefferson, G., & Sacks, H. (1977). The preference for self-correction in the organization of repair in conversation. *Language*, 53, 361-382.
- Schenkein, J. (1980). A taxonomy for repeating action sequences in natural conversation. In B. Butterworth (Ed.) *Language production*, Vol.1, (pp.21-47). London: Academic Press.
- Schriefers, H. (1990). Lexical and conceptual factors in the naming of relations. *Cognitive Psychology*, 22, 111-142.
- Schriefers, H. (1993). Syntactic processes in the production of noun phrases. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 19, 841-850.
- Schriefers, H., Meyer, A. S., & Levelt, W. J. M. (1990). Exploring the Time Course of Lexical Access in Language Production: Picture-Word Interference Studies. *Journal of Memory and Language*, 29, 86-102.
- Skut, W, Krenn, B, Brants T, & Uszkoreit, H. (1997). An annotation scheme for free word order languages. In *Proceedings of the 5th Conference on Applied Natural Language Processing*, Washington.
- Smith, M.C., & Wheeldon, L.R. (1999). High level processing scope in spoken sentence production. *Cognition*, 73, 205-246.
- Smith, M.C, & Wheeldon, L.R. (2001). Syntactic priming in spoken sentence production: An online study. *Cognition*, 78, 123-164.
- Starreveld, P. A., & La Heij, W. L. (1995). Semantic interference, orthographic facilitation, and their interaction in naming tasks. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 21, 686-698.
- Starreveld, P. A., & La Heij, W. L. (1996a), Time-course analysis of semantic and orthographic context effects in picture naming. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 22, 896-918.

- Starreveld, P. A., & La Heij, W. L. (1996b). The locus of orthographic-phonological facilitation and their interaction in naming tasks. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 22, 686-698.
- Stemberger, J. P. (1982). Syntactic Errors in Speech. *Journal of Psycholinguistic Research*, 11, 313-345.
- Stemberger, J. P. (1985). An Interactive Activation Model of Language Production. In A. W. Ellis (Ed.), *Progress in the psychology of Language, Vol. 1*, (pp. 143- 186). LEA, Lawrence Erlbaum Associates.
- Tamaoka, K., Sakai, H., Kawahara, J., Miyaoka, Y., Lim, H., & Koizumi, M. (2005). Priority information used for the processing of Japanese sentences: Thematic roles, case particles or grammatical functions? *Journal of Psycholinguistic Research*, 34, 273-324
- Tanaka, M., Branigan, H.P., & Pickering, M.J., (2005). The role of animacy in Japanese sentence production. Paper presented at the CUNY Sentence Processing Conference, Tucson AZ.
- Tannen, D. (1989). *Talking voices: Repetition, dialogue and imagery in conversational discourse*. Cambridge: Cambridge University Press.
- Tannenbaum, P. H., & Williams, F. (1968). Generation of active and passive sentences as a function of subjects and object focus. *Journal of Verbal Learning and Verbal Behaviour*, 7, 246-250.
- Van Nice, K.Y., & Dietrich, R. (2003). Task sensitivity of animacy effects: evidence from German picture descriptions. *Linguistics*, 41, 825-849.
- Vigliocco, G., Antonini, T., & Garrett, M.F. (1997). Grammatical gender is on the tip of Italian tongues. *Psychological Science*, 8, 314-317.
- Vigliocco, G., Butterworth, B., & Garrett, M. F. (1996). Subject-verb agreement in Spanish and English: Differences in role of conceptual constraints. *Cognition*, 61, 261-298.
- Vigliocco, G., Vinson, D.P., Martin, R.C., & Garrett, M.F. (1999). Is "count" and "mass" information available when the noun is not? An investigation of tip of the tongue states and anomia. *Journal of Memory and Language*, 40, 534-558.

- Weiner, E. J., & Labov, W. (1983). Constraints on the agentless passive. *Journal of Linguistics*, 19, 29-58.
- Wells, R. (1951). Predicting slips of the tongue. *Yale Scientific Magazine*, 26, 9-30.
- Wheeldon, L. R., & Smith M.C. (2003). Phrase structure priming: A short-lived effect. *Language and Cognitive Processes*, 18, 431-442.
- James, W. (1950). *Principles of psychology*. New York: Holt. (Original work published in 1890)
- Wolfart, H. C & Carroll. J. F. (1981). *Meet Cree. A guide to the language*. Lincoln: University of Nebraska Press.
- Woodworth, R. S. (1938). *Experimental psychology*. New York: Henry Holt.
- Yamamoto, M. (1999) *Animacy and Reference: A Cognitive Approach to Corpus Linguistics*. Amsterdam: Benjamins.
- Yamashita, H. (1997). The effects of word-order and case marking information on the processing of Japanese. *Journal of Psycholinguistic Research*, 26, 163-188.
- Yamashita, H (2002) Scrambled sentences in Japanese: Linguistic properties and motivations for production, *Text*, 22, 597-633.
- Yamashita, H., & Chang, F. (2001). "Long before short" preference in the production of a head-final language. *Cognition*, 81, B45-B55.

Appendix 1: Experiment 1 sentences

Abbreviations

An = Animate, In = Inanimate

SOV = Subject-Object-Verb, OSV = Object-Subject-Verb, Conj = Conjunct

- | | | |
|---|------------|---------------------------|
| 1 | An-In-SOV | 地球では、人間が環境を壊している。 |
| | In-An-SOV | 地球では、環境が人間を壊している。 |
| | An-In-OSV | 地球では、人間を環境が壊している。 |
| | In-An-OSV | 地球では、環境を人間が壊している。 |
| | An-In-Conj | 地球では、人間と環境が深く関わりあっている。 |
| | In-An-Conj | 地球では、環境と人間が深く関わりあっている。 |
| | | |
| 2 | An-In-SOV | クリスマスの後、買い物客がバーゲンを待っていた。 |
| | In-An-SOV | クリスマスの後、バーゲンが買い物客を待っていた。 |
| | An-In-OSV | クリスマスの後、買い物客をバーゲンが待っていた。 |
| | In-An-OSV | クリスマスの後、バーゲンを買い物客が待っていた。 |
| | An-In-Conj | クリスマスの後、買い物客とバーゲンは切り離せない。 |
| | In-An-Conj | クリスマスの後、バーゲンと買い物客は切り離せない。 |
| | | |
| 3 | An-In-SOV | 洪水から、村民が大きな木を守った。 |
| | In-An-SOV | 洪水から、大きな木が村民を守った。 |
| | An-In-OSV | 洪水から、村民を大きな木が守った。 |
| | In-An-OSV | 洪水から、大きな木を村民が守った。 |
| | An-In-Conj | 洪水から、村民と大きな木が守られた。 |
| | In-An-Conj | 洪水から、大きな木と村民が守られた。 |
| | | |
| 4 | An-In-SOV | 急な坂で、登山者が車を押した。 |
| | In-An-SOV | 急な坂で、車が登山者を押した。 |
| | An-In-OSV | 急な坂で、登山者を車が押した。 |
| | In-An-OSV | 急な坂で、車を登山者が押した。 |
| | An-In-Conj | 急な坂で、登山者と車が押された。 |
| | In-An-Conj | 急な坂で、車と登山者が押された。 |
| | | |
| 5 | An-In-SOV | 町の真中で、交通警察官がジープを止めた。 |
| | In-An-SOV | 町の真中で、ジープが交通警察官を止めた。 |

- An-In-OSV 町の真中で、交通警察官をジープが止めた。
 In-An-OSV 町の真中で、ジープを交通警察官が止めた。
 An-In-Conj 町の真中で、交通警察官とジープが止まった。
 In-An-Conj 町の真中で、ジープと交通警察官が止まった。
- 6 An-In-SOV 建設地で、役員が石をつぶした。
 In-An-SOV 建設地で、石が役員をつぶした。
 An-In-OSV 建設地で、役員を石がつぶした。
 In-An-OSV 建設地で、石を役員がつぶした。
 An-In-Conj 建設地で、役員と石がぶつかった。
 In-An-Conj 建設地で、石と役員がぶつかった。
- 7 An-In-SOV 港で、漁師がボートを運んだ。
 In-An-SOV 港で、ボートが漁師を運んだ。
 An-In-OSV 港で、漁師をボートが運んだ。
 In-An-OSV 港で、ボートを漁師が運んだ。
 An-In-Conj 港で、漁師とボートが動いていた。
 In-An-Conj 港で、ボートと漁師が動いていた。
- 8 An-In-SOV 駐車場で、バスの運転手がトラックを轢いた。
 In-An-SOV 駐車場で、トラックがバスの運転手を轢いた。
 An-In-OSV 駐車場で、バスの運転手をトラックが轢いた。
 In-An-OSV 駐車場で、トラックをバスの運転手が轢いた。
 An-In-Conj 駐車場で、バスの運転手とトラックが同じ位置にいた。
 In-An-Conj 駐車場で、トラックとバスの運転手が同じ位置にいた。
- 9 An-In-SOV 国立公園で、植木屋が木の幹を倒した。
 In-An-SOV 国立公園で、木の幹が植木屋を倒した。
 An-In-OSV 国立公園で、植木屋を木の幹が倒した。
 In-An-OSV 国立公園で、木の幹を植木屋が倒した。
 An-In-Conj 国立公園で、植木屋と木の幹が風にさらされた。
 In-An-Conj 国立公園で、木の幹と植木屋が風にさらされた。
- 10 An-In-SOV 台所で、コックが皿を汚した。
 In-An-SOV 台所で、皿がコックを汚した。

- | | |
|--------------|-------------------------|
| An-In-OSV | 台所で、コックを皿が汚した。 |
| In-An-OSV | 台所で、皿をコックが汚した。 |
| An-In-Conj | 台所で、コックと皿が両方とも汚れていた。 |
| In-An-Conj | 台所で、皿とコックが両方とも汚れていた。 |
| | |
| 11 An-In-SOV | 温泉で、おかみがシャワーを濡らした。 |
| In-An-SOV | 温泉で、シャワーがおかみを濡らした。 |
| An-In-OSV | 温泉で、おかみをシャワーが濡らした。 |
| In-An-OSV | 温泉で、シャワーをおかみが濡らした。 |
| An-In-Conj | 温泉で、おかみとシャワーが濡れていた。 |
| In-An-Conj | 温泉で、シャワーとおかみが濡れていた。 |
| | |
| 12 An-In-SOV | ジャングルで、ゴリラが木を踏んだ。 |
| In-An-SOV | ジャングルで、木がゴリラを踏んだ。 |
| An-In-OSV | ジャングルで、ゴリラを木が踏んだ。 |
| In-An-OSV | ジャングルで、木をゴリラが踏んだ。 |
| An-In-Conj | ジャングルで、ゴリラと木が監視されていた。 |
| In-An-Conj | ジャングルで、木とゴリラが監視されていた。 |
| | |
| 13 An-In-SOV | 植物園で、園芸家が木の枝を切った。 |
| In-An-SOV | 植物園で、木の枝が園芸家を切った。 |
| An-In-OSV | 植物園で、園芸家を木の枝が切った。 |
| In-An-OSV | 植物園で、木の枝を園芸家が切った。 |
| An-In-Conj | 植物園で、園芸家と木の枝が写真に写っていた。 |
| In-An-Conj | 植物園で、木の枝と園芸家が写真に写っていた。 |
| | |
| 14 An-In-SOV | 新しい部屋で、建設者がランプを照らしていた。 |
| In-An-SOV | 新しい部屋で、ランプが建設者を照らしていた。 |
| An-In-OSV | 新しい部屋で、建設者をランプが照らしていた。 |
| In-An-OSV | 新しい部屋で、ランプを建設者が照らしていた。 |
| An-In-Conj | 新しい部屋で、建設者とランプが照らされていた。 |
| In-An-Conj | 新しい部屋で、ランプと建設者が照らされていた。 |
| | |
| 15 An-In-SOV | おとぎ話で、魔法使いが魔法の杖をつついた。 |
| In-An-SOV | おとぎ話で、魔法の杖が魔法使いをつついた。 |

- An-In-OSV おとし話で、魔法使いを魔法の杖がつついた。
 In-An-OSV おとし話で、魔法の杖を魔法使いがつついた。
 An-In-Conj おとし話で、魔法使いと魔法の杖が現われた。
 In-An-Conj おとし話で、魔法の杖と魔法使いが現われた。
- 16 An-In-SOV 畑の近くで、サルが網を掴まえた。
 In-An-SOV 畑の近くで、網がサルを掴まえた。
 An-In-OSV 畑の近くで、サルを網が掴まえた。
 In-An-OSV 畑の近くで、網をサルが掴まえた。
 An-In-Conj 畑の近くで、サルと網が絡まっていた。
 In-An-Conj 畑の近くで、網とサルが絡まっていた。
- 17 An-In-SOV 遊園地で、観光客が大きなバスを進めた。
 In-An-SOV 遊園地で、大きなバスが観光客を進めた。
 An-In-OSV 遊園地で、観光客を大きなバスが進めた。
 In-An-OSV 遊園地で、大きなバスを観光客が進めた。
 An-In-Conj 遊園地で、観光客と大きなバスが待っていた。
 In-An-Conj 遊園地で、大きなバスと観光客が一行に待っていた。
- 18 An-In-SOV 海辺で、競泳者が救命ボートを届けた。
 In-An-SOV 海辺で、救命ボートが競泳者を届けた。
 An-In-OSV 海辺で、競泳者を救命ボートが届けた。
 In-An-OSV 海辺で、救命ボートを競泳者が届けた。
 An-In-Conj 海辺で、競泳者と救命ボートが救命用に備えられた。
 In-An-Conj 海辺で、救命ボートと競泳者が救命用に備えられた。
- 19 An-In-SOV 風呂の後、銭湯のオーナーがドライヤーを乾かした。
 In-An-SOV 風呂の後、ドライヤーが銭湯のオーナーを乾かした。
 An-In-OSV 風呂の後、銭湯のオーナーをドライヤーが乾かした。
 In-An-OSV 風呂の後、ドライヤーを銭湯のオーナーが乾かした。
 An-In-Conj 風呂の後、銭湯のオーナーとドライヤーが消えた。
 In-An-Conj 風呂の後、ドライヤーと銭湯のオーナーが消えた。
- 20 An-In-SOV デパートの遊び場で、赤ちゃんがおもちゃの車を転がした。
 In-An-SOV デパートの遊び場で、おもちゃの車が赤ちゃんを転がした。

- An-In-OSV デパートの遊び場で、赤ちゃんをおもちゃの車が転がした。
 In-An-OSV デパートの遊び場で、おもちゃの車を赤ちゃんが転がした。
 An-In-Conj デパートの遊び場で、赤ちゃんとおもちゃの車が
 同じ箱に入っていた。
 In-An-Conj デパートの遊び場で、おもちゃの車と赤ちゃんが
 同じ箱に入っていた。
- 21 An-In-SOV 工事現場で、力持ちの作業員がブルドーザーを持ち上げた。
 In-An-SOV 工事現場で、ブルドーザーが力持ちの作業員を持ち上げた。
 An-In-OSV 工事現場で、力持ちの作業員をブルドーザーが持ち上げた。
 In-An-OSV 工事現場で、ブルドーザーを力持ちの作業員が持ち上げた。
 An-In-Conj 工場現場で、力持ちの作業員とブルドーザーが遅れて着いた。
 In-An-Conj 工事現場で、ブルドーザーと力持ちの作業員が遅れて着いた。
- 22 An-In-SOV 野原で、農夫が土を汚くした。
 In-An-SOV 野原で、土が農夫を汚くした。
 An-In-OSV 野原で、農夫を土が汚くした。
 In-An-OSV 野原で、土を農夫が汚くした。
 An-In-Conj 野原で、農夫と土が埋められた。
 In-An-Conj 野原で、土と農夫が埋められた。
- 23 An-In-SOV 洗面所で、クリーナーがブラシを掃いた。
 In-An-SOV 洗面所で、ブラシがクリーナーを掃いた。
 An-In-OSV 洗面所で、クリーナーをブラシが掃いた。
 In-An-OSV 洗面所で、ブラシをクリーナーが掃いた。
 An-In-Conj 洗面所で、クリーナーとブラシが消毒された。
 In-An-Conj 洗面所で、ブラシとクリーナーが消毒された。
- 24 An-In-SOV 政府への反対運動のため、指導者が革命を刺激した。
 In-An-SOV 政府への反対運動のため、革命が指導者を刺激した。
 An-In-OSV 政府への反対運動のため、指導者を革命が刺激した。
 In-An-OSV 政府への反対運動のため、革命を指導者が刺激した。
 An-In-Conj 政府への反対運動のため、指導者と革命が歴史の本に載った。
 In-An-Conj 政府への反対運動のため、革命と指導者が歴史の本に載った。

- 25 An-In-SOV 実験中、研究者が危険な液体を燃やした。
 In-An-SOV 実験中、危険な液体が研究者を燃やした。
 An-In-OSV 実験中、研究者を危険な液体が燃やした。
 In-An-OSV 実験中、危険な液体を研究者が燃やした。
 An-In-Conj 実験中、研究者と危険な液体はいつも隣り合わせだった。
 In-An-Conj 実験中、危険な液体と研究者はいつも隣り合わせだった。
- 26 An-In-SOV 喫茶店で、ウェイトレスがコーヒーを温めた。
 In-An-SOV 喫茶店で、コーヒーがウェイトレスを温めた。
 An-In-OSV 喫茶店で、ウェイトレスをコーヒーが温めた。
 In-An-OSV 喫茶店で、コーヒーをウェイトレスが温めた。
 An-In-Conj 喫茶店で、ウェイトレスとコーヒーが
 リラックスした雰囲気を作った。
 In-An-Conj 喫茶店で、コーヒーとウェイトレスが
 リラックスした雰囲気を作った。
- 27 An-In-SOV 山火事の際、消防員が森を守った。
 In-An-SOV 山火事の際、森が消防員を守った。
 An-In-OSV 山火事の際、消防員を森が守った。
 In-An-OSV 山火事の際、森を消防員が守った。
 An-In-Conj 山火事の際、消防員と森が危機にさらされた。
 In-An-Conj 山火事の際、森と消防員が危機にさらされた。
- 28 An-In-SOV 崖から、ロッククライマーが大きな岩を落とした。
 In-An-SOV 崖から、大きな岩がロッククライマーを落とした。
 An-In-OSV 崖から、ロッククライマーを大きな岩が落とした。
 In-An-OSV 崖から、大きな岩をロッククライマーが落とした。
 An-In-Conj 崖から、ロッククライマーと大きな岩が同時に落ちた。
 In-An-Conj 崖から、大きな岩とロッククライマーが同時に落ちた。
- 29 An-In-SOV 船を引き戻すため、船長がロープを縛った。
 In-An-SOV 船を引き戻すため、ロープが船長を縛った。
 An-In-OSV 船を引き戻すため、船長をロープが縛った。
 In-An-OSV 船を引き戻すため、ロープを船長が縛った。
 An-In-Conj 船を引き戻すため、船長とロープが縛られた。
 In-An-Conj 船を引き戻すため、ロープと船長が縛られた。

- 30 An-In-SOV 空港から、パイロットが管制塔を呼んだ。
 In-An-SOV 空港から、管制塔がパイロットを呼んだ。
 An-In-OSV 空港から、パイロットを管制塔が呼んだ。
 In-An-OSV 空港から、管制塔をパイロットが呼んだ。
 An-In-Conj 空港から、パイロットと管制塔が頻繁に連絡しあった。
 In-An-Conj 空港から、管制塔とパイロットが頻繁に連絡しあった。
- 31 An-In-SOV 駅前で、旅行者がタクシーをひろった。
 In-An-SOV 駅前で、タクシーが旅行者をひろった。
 An-In-OSV 駅前で、旅行者をタクシーがひろった。
 In-An-OSV 駅前で、タクシーを旅行者がひろった。
 An-In-Conj 駅前で、旅行者とタクシーが待っていた。
 In-An-Conj 駅前で、タクシーと旅行者が待っていた。
- 32 An-In-SOV 川の真中で、海軍軍人が潜水艦を沈めた。
 In-An-SOV 川の真中で、潜水艦が海軍軍人を沈めた。
 An-In-OSV 川の真中で、海軍軍人を潜水艦が沈めた。
 In-An-OSV 川の真中で、潜水艦を海軍軍人が沈めた。
 An-In-Conj 川の真中で、海軍軍人と潜水艦が沈んだ。
 In-An-Conj 川の真中で、潜水艦と海軍軍人が沈んだ。
- 33 An-In-SOV 病院の前で、医者が救急車を追いかけた。
 In-An-SOV 病院の前で、救急車が医者を追いかけた。
 An-In-OSV 病院の前で、医者を救急車が追いかけた。
 In-An-OSV 病院の前で、救急車を医者が追いかけた。
 An-In-Conj 病院の前で、医者と救急車が他の患者を邪魔した。
 In-An-Conj 病院の前で、救急車と医者が他の患者を邪魔した。
- 34 An-In-SOV 長年の研究で、科学者がその発見を有名にした。
 In-An-SOV 長年の研究で、その発見が科学者を有名にした。
 An-In-OSV 長年の研究で、科学者をその発見が有名にした。
 In-An-OSV 長年の研究で、その発見を科学者が有名にした。
 An-In-Conj 長年の研究で、科学者とその発見が有名となった。
 In-An-Conj 長年の研究で、その発見と科学者が有名となった。

- 35 An-In-SOV 過去の学業業績により、教授がこの本を誉めた。
 In-An-SOV 過去の学業業績により、この本が教授を誉めた。
 An-In-OSV 過去の学業業績により、教授をこの本が誉めた。
 In-An-OSV 過去の学業業績により、この本を教授が誉めた。
 An-In-Conj 過去の学業業績により、教授とこの本が表彰された。
 In-An-Conj 過去の学業業績により、この本と教授が表彰された。
- 36 An-In-SOV 戦争中に、軍人が爆弾を爆破した。
 In-An-SOV 戦争中に、爆弾が軍人を爆破した。
 An-In-OSV 戦争中に、軍人を爆弾が爆破した。
 In-An-OSV 戦争中に、爆弾を軍人が爆破した。
 An-In-Conj 戦争中に、軍人と爆弾が爆破された。
 In-An-Conj 戦争中に、爆弾と軍人が爆破された。
- 37 An-In-SOV 宗教の世界の中で、イスラム教徒が聖書を拒絶した。
 In-An-SOV 宗教の世界の中で、聖書がイスラム教徒を拒絶した。
 An-In-OSV 宗教の世界の中で、イスラム教徒を聖書が拒絶した。
 In-An-OSV 宗教の世界の中で、聖書をイスラム教徒が拒絶した。
 An-In-Conj 宗教の世界の中で、イスラム教徒と聖書が主な問題だった。
 In-An-Conj 宗教の世界の中で、聖書とイスラム教徒が主な問題だった。
- 38 An-In-SOV 今回の事件で、刑事が調査を妨げた。
 In-An-SOV 今回の事件で、調査が刑事を妨げた。
 An-In-OSV 今回の事件で、刑事を調査が妨げた。
 In-An-OSV 今回の事件で、調査を刑事が妨げた。
 An-In-Conj 今回の事件で、刑事と調査が注目された。
 In-An-Conj 今回の事件で、調査と刑事が注目された。
- 39 An-In-SOV オフィスで、講師が本棚を押し出した。
 In-An-SOV オフィスで、本棚が講師を押し出した。
 An-In-OSV オフィスで、講師を本棚が押し出した。
 In-An-OSV オフィスで、本棚が講師が押し出した。
 An-In-Conj オフィスで、講師と本棚が倒れた。
 In-An-Conj オフィスで、本棚と講師が倒れた。

- 40 An-In-SOV ガソリンスタンドで、トラックの運転手がバイクを囲んだ。
 In-An-SOV ガソリンスタンドで、バイクがトラックの運転手を囲んだ。
 An-In-OSV ガソリンスタンドで、トラックの運転手をバイクが囲んだ。
 In-An-OSV ガソリンスタンドで、バイクをトラックの運転手が囲んだ。
 An-In-Conj ガソリンスタンドで、トラックの運転手とバイクが
 列を止めた。
 In-An-Conj ガソリンスタンドで、バイクとトラックの運転手が
 列を止めた。
- 41 An-In-SOV ビルの火災の際、警備員が最新の設備を救った。
 In-An-SOV ビルの火災の際、最新の設備が警備員を救った。
 An-In-OSV ビルの火災の際、警備員を最新の設備が救った。
 In-An-OSV ビルの火災の際、最新の設備を警備員が救った。
 An-In-Conj ビルの火災の際、警備員と最新の設備が役立った。
 In-An-Conj ビルの火災の際、最新の設備と警備員が役立った。
- 42 An-In-SOV デパートで、店長が隠しカメラを写した。
 In-An-SOV デパートで、隠しカメラが店長を写した。
 An-In-OSV デパートで、店長を隠しカメラが写した。
 In-An-OSV デパートで、隠しカメラを店長が写した。
 An-In-Conj デパートで、店長と隠しカメラが安全に役立った。
 In-An-Conj デパートで、隠しカメラと店長が安全に役立った。

Appendix 2: Experiment 1 Filler sentences

Filler sentences

- 1 飛行機のなかで、赤ん坊が泣いた。
- 2 閉館時間を過ぎたため、図書館が閉まった。
- 3 幼稚園で、子供たちが騒いだ。
- 4 東京駅から、新幹線が走っている。
- 5 コンサートで、歌手が転んだ。
- 6 いい天気のおかげで、洗濯物が乾いた。
- 7 警察が着くまえに、犯人が逃げた。
- 8 ホテル係員の素早い対応のおかげで、混乱が収まった。
- 9 サッカーの試合中に、選手が倒れた。
- 10 大学の記念会館で、入学式が始まった。
- 11 交通事故のため、サイクリストが死んだ。
- 12 経済の不況から、失業率が増えた。
- 13 動物園で、キリンが眠った。

- 14 ピクニックの間、雨が降った。
- 15 体育館での練習で、バレリーナが踊った。
- 16 開いている窓の近くで、花瓶が落ちた。
- 17 水族館のプールで、イルカが泳いだ。
- 18 毎日夜8時頃に、太陽が沈む。
- 19 駅のプラットフォームで、女子高生が座っていた。
- 20 暖かい気候のなかで、パイナップルが育つ。
- 21 吹雪のなかでも、鳥が飛んだ。
- 22 地震の影響で、塔が倒れた。

Appendix 3: Experiment 2 sentences

Abbreviations

An = Animate, In = Inanimate

Act = Active, Pas = Passive

SOV = Subject-Object-Verb, OSV = Object-Subject-Verb

Obl = Oblique

- | | | |
|---|--------------------|-----------------------------|
| 1 | S(An)-O(In)-act | 地球では、人間が環境を壊している。 |
| | S(In)-O(An)-act | 地球では、環境が人間を壊している。 |
| | O(An)-S(In)-act | 地球では、人間を環境が壊している。 |
| | O(In)-S(An)-act | 地球では、環境を人間が壊している。 |
| | S(An)-O(In)obl-pas | 地球では、人間が環境によって壊されている。 |
| | S(In)-O(An)obl-pas | 地球では、環境が人間によって壊されている。 |
| | O(An)obl-S(In)-pas | 地球では、人間によって環境が壊されている。 |
| | O(In)obl-S(An)-pas | 地球では、環境によって人間が壊されている。 |
| | | |
| 2 | S(An)-O(In)-act | クリスマスの後、買い物客がバーゲンを待っていた。 |
| | S(In)-O(An)-act | クリスマスの後、バーゲンが買い物客を待っていた。 |
| | O(An)-S(In)-act | クリスマスの後、買い物客をバーゲンが待っていた。 |
| | O(In)-S(An)-act | クリスマスの後、バーゲンを買い物客が待っていた。 |
| | S(An)-O(In)obl-pas | クリスマスの後、買い物客がバーゲンによって待たされた。 |
| | S(In)-O(An)obl-pas | クリスマスの後、バーゲンが買い物客によって待たされた。 |
| | O(An)obl-S(In)-pas | クリスマスの後、買い物客によってバーゲンが待たされた。 |
| | O(In)obl-S(An)-pas | クリスマスの後、バーゲンによって買い物客が待たされた。 |
| | | |
| 3 | S(An)-O(In)-act | 洪水から、村民が大きな木を守った。 |
| | S(In)-O(An)-act | 洪水から、大きな木が村民を守った。 |
| | O(An)-S(In)-act | 洪水から、村民を大きな木が守った。 |
| | O(In)-S(An)-act | 洪水から、大きな木を村民が守った。 |
| | S(An)-O(In)obl-pas | 洪水から、村民が大きな木によって守られた。 |
| | S(In)-O(An)obl-pas | 洪水から、大きな木が村民によって守られた。 |
| | O(An)obl-S(In)-pas | 洪水から、村民によって大きな木が守られた。 |
| | O(In)obl-S(An)-pas | 洪水から、大きな木によって村民が守られた。 |

- 4 S(An)-O(In)-act 急な坂で、登山者が車を押した。
 S(In)-O(An)-act 急な坂で、車が登山者を押した。
 O(An)-S(In)-act 急な坂で、登山者を車が押した。
 O(In)-S(An)-act 急な坂で、車を登山者が押した。
 S(An)-O(In)obl-pas 急な坂で、登山者が車によって押された。
 S(In)-O(An)obl-pas 急な坂で、車が登山者によって押された。
 O(An)obl-S(In)-pas 急な坂で、登山者によって車が押された。
 O(In)obl-S(An)-pas 急な坂で、車によって登山者が押された。
- 5 S(An)-O(In)-act 町の真中で、交通警察官がジープを止めた。
 S(In)-O(An)-act 町の真中で、ジープが交通警察官を止めた。
 O(An)-S(In)-act 町の真中で、交通警察官をジープが止めた。
 O(In)-S(An)-act 町の真中で、ジープを交通警察官が止めた。
 S(An)-O(In)obl-pas 町の真中で、交通警察官がジープによって止められた。
 S(In)-O(An)obl-pas 町の真中で、ジープが交通警察官によって止められた。
 O(An)obl-S(In)-pas 町の真中で、交通警察官によってジープが止められた。
 O(In)obl-S(An)-pas 町の真中で、ジープによって交通警察官が止められた。
- 6 S(An)-O(In)-act 建設地で、役員が石をつぶした。
 S(In)-O(An)-act 建設地で、石が役員をつぶした。
 O(An)-S(In)-act 建設地で、役員を石がつぶした。
 O(In)-S(An)-act 建設地で、石を役員がつぶした。
 S(An)-O(In)obl-pas 建設地で、役員が石によってつぶされた。
 S(In)-O(An)obl-pas 建設地で、石が役員によってつぶされた。
 O(An)obl-S(In)-pas 建設地で、役員によって石がつぶされた。
 O(In)obl-S(An)-pas 建設地で、石によって役員がつぶされた。
- 7 S(An)-O(In)-act 港で、漁師がボートを運んだ。
 S(In)-O(An)-act 港で、ボートが漁師を運んだ。
 O(An)-S(In)-act 港で、漁師をボートが運んだ。
 O(In)-S(An)-act 港で、ボートを漁師が運んだ。
 S(An)-O(In)obl-pas 港で、漁師がボートによって運ばれた。
 S(In)-O(An)obl-pas 港で、ボートが漁師によって運ばれた。
 O(An)obl-S(In)-pas 港で、漁師によってボートが運ばれた。
 O(In)obl-S(An)-pas 港で、ボートによって漁師が運ばれた。

- 8 S(An)-O(In)-act 駐車場で、バスの運転手がトラックを引いた。
 S(In)-O(An)-act 駐車場で、トラックがバスの運転手を引いた。
 O(An)-S(In)-act 駐車場で、バスの運転手をトラックが引いた。
 O(In)-S(An)-act 駐車場で、トラックをバスの運転手が引いた。
 S(An)-O(In)obl-pas 駐車場で、バスの運転手がトラックによって引かれた。
 S(In)-O(An)obl-pas 駐車場で、トラックがバスの運転手によって引かれた。
 O(An)obl-S(In)-pas 駐車場で、バスの運転手によってトラックが引かれた。
 O(In)obl-S(An)-pas 駐車場で、トラックによってバスの運転手が引かれた。
- 9 S(An)-O(In)-act 国立公園で、植木屋が木の幹を倒した。
 S(In)-O(An)-act 国立公園で、木の幹が植木屋を倒した。
 O(An)-S(In)-act 国立公園で、植木屋を木の幹が倒した。
 O(In)-S(An)-act 国立公園で、木の幹を植木屋が倒した。
 S(An)-O(In)obl-pas 国立公園で、植木屋が木の幹によって倒された。
 S(In)-O(An)obl-pas 国立公園で、木の幹が植木屋によって倒された。
 O(An)obl-S(In)-pas 国立公園で、植木屋によって木の幹が倒された。
 O(In)obl-S(An)-pas 国立公園で、木の幹によって植木屋が倒された。
- 10 S(An)-O(In)-act 台所で、コックが皿を汚した。
 S(In)-O(An)-act 台所で、皿がコックを汚した。
 O(An)-S(In)-act 台所で、コックを皿が汚した。
 O(In)-S(An)-act 台所で、皿をコックが汚した。
 S(An)-O(In)obl-pas 台所で、コックが皿によって汚された。
 S(In)-O(An)obl-pas 台所で、皿がコックによって汚された。
 O(An)obl-S(In)-pas 台所で、コックによって皿が汚された。
 O(In)obl-S(An)-pas 台所で、皿によってコックが汚された。
- 11 S(An)-O(In)-act 温泉で、おかみがシャワーを濡らした。
 S(In)-O(An)-act 温泉で、シャワーがおかみを濡らした。
 O(An)-S(In)-act 温泉で、おかみをシャワーが濡らした。
 O(In)-S(An)-act 温泉で、シャワーをおかみが濡らした。
 S(An)-O(In)obl-pas 温泉で、おかみがシャワーによって濡らされた。
 S(In)-O(An)obl-pas 温泉で、シャワーがおかみによって濡らされた。
 O(An)obl-S(In)-pas 温泉で、おかみによってシャワーが濡らされた。
 O(In)obl-S(An)-pas 温泉で、シャワーによっておかみが濡らされた。

- 12 S(An)-O(In)-act ジャングルで、ゴリラが木を踏んだ。
 S(In)-O(An)-act ジャングルで、木がゴリラを踏んだ。
 O(An)-S(In)-act ジャングルで、ゴリラを木が踏んだ。
 O(In)-S(An)-act ジャングルで、木をゴリラが踏んだ。
 S(An)-O(In)obl-pas ジャングルで、ゴリラが木によって踏まれた。
 S(In)-O(An)obl-pas ジャングルで、木がゴリラによって踏まれた。
 O(An)obl-S(In)-pas ジャングルで、ゴリラによって木が踏まれた。
 O(In)obl-S(An)-pas ジャングルで、木によってゴリラが踏まれた。
- 13 S(An)-O(In)-act 植物園で、園芸家が木の枝を切った。
 S(In)-O(An)-act 植物園で、木の枝が園芸家を切った。
 O(An)-S(In)-act 植物園で、園芸家を木の枝が切った。
 O(In)-S(An)-act 植物園で、木の枝を園芸家が切った。
 S(An)-O(In)obl-pas 植物園で、園芸家が木の枝によって切られた。
 S(In)-O(An)obl-pas 植物園で、木の枝が園芸家によって切られた。
 O(An)obl-S(In)-pas 植物園で、園芸家によって木の枝が切られた。
 O(In)obl-S(An)-pas 植物園で、木の枝によって園芸家が切られた。
- 14 S(An)-O(In)-act 新しい部屋で、建設者がランプを照らしていた。
 S(In)-O(An)-act 新しい部屋で、ランプが建設者を照らしていた。
 O(An)-S(In)-act 新しい部屋で、建設者をランプが照らしていた。
 O(In)-S(An)-act 新しい部屋で、ランプを建設者が照らしていた。
 S(An)-O(In)obl-pas 新しい部屋で、建設者がランプによって照らされていた。
 S(In)-O(An)obl-pas 新しい部屋で、ランプが建設者によって照らされていた。
 O(An)obl-S(In)-pas 新しい部屋で、建設者によってランプが照らされていた。
 O(In)obl-S(An)-pas 新しい部屋で、ランプによって建設者が照らされていた。
- 15 S(An)-O(In)-act おとぎ話で、魔法使いが魔法の杖をつついた。
 S(In)-O(An)-act おとぎ話で、魔法の杖が魔法使いをつついた。
 O(An)-S(In)-act おとぎ話で、魔法使いを魔法の杖がつついた。
 O(In)-S(An)-act おとぎ話で、魔法の杖を魔法使いがつついた。
 S(An)-O(In)obl-pas おとぎ話で、魔法使いが魔法の杖によってつつかれた。
 S(In)-O(An)obl-pas おとぎ話で、魔法の杖が魔法使いによってつつかれた。
 O(An)obl-S(In)-pas おとぎ話で、魔法使いによって魔法の杖がつつかれた。
 O(In)obl-S(An)-pas おとぎ話で、魔法の杖によって魔法使いがつつかれた。

- 16 S(An)-O(In)-act 畑の近くで、サルが網を掴まえた。
 S(In)-O(An)-act 畑の近くで、網がサルを掴まえた。
 O(An)-S(In)-act 畑の近くで、サルを網が掴まえた。
 O(In)-S(An)-act 畑の近くで、網をサルが掴まえた。
 S(An)-O(In)obl-pas 畑の近くで、サルが網によって掴まえられた。
 S(In)-O(An)obl-pas 畑の近くで、網がサルによって掴まえられた。
 O(An)obl-S(In)-pas 畑の近くで、サルによって網が掴まえられた。
 O(In)obl-S(An)-pas 畑の近くで、網によってサルが掴まえられた。
- 17 S(An)-O(In)-act 遊園地では、観光客が大きなバスを進めた。
 S(In)-O(An)-act 遊園地では、大きなバスが観光客を進めた。
 O(An)-S(In)-act 遊園地では、観光客を大きなバスが進めた。
 O(In)-S(An)-act 遊園地では、大きなバスを観光客が進めた。
 S(An)-O(In)obl-pas 遊園地では、観光客が大きなバスによって進められた。
 S(In)-O(An)obl-pas 遊園地では、大きなバスが観光客によって進められた。
 O(An)obl-S(In)-pas 遊園地では、観光客によって大きなバスが進められた。
 O(In)obl-S(An)-pas 遊園地では、大きなバスによって観光客が進められた。
- 18 S(An)-O(In)-act 海辺で、競泳者が救命ボートを届けた。
 S(In)-O(An)-act 海辺で、救命ボートが競泳者を届けた。
 O(An)-S(In)-act 海辺で、競泳者を救命ボートが届けた。
 O(In)-S(An)-act 海辺で、救命ボートを競泳者が届けた。
 S(An)-O(In)obl-pas 海辺で、競泳者が救命ボートによって届けられた。
 S(In)-O(An)obl-pas 海辺で、救命ボートが競泳者によって届けられた。
 O(An)obl-S(In)-pas 海辺で、競泳者によって救命ボートが届けられた。
 O(In)obl-S(An)-pas 海辺で、救命ボートによって競泳者が届けられた。
- 19 S(An)-O(In)-act 風呂の後、銭湯のオーナーがドライヤーを乾かした。
 S(In)-O(An)-act 風呂の後、ドライヤーが銭湯のオーナーを乾かした。
 O(An)-S(In)-act 風呂の後、銭湯のオーナーをドライヤーが乾かした。
 O(In)-S(An)-act 風呂の後、ドライヤーを銭湯のオーナーが乾かした。
 S(An)-O(In)obl-pas 風呂の後、銭湯のオーナーがドライヤーによって乾かされた。
 S(In)-O(An)obl-pas 風呂の後、ドライヤーが銭湯のオーナーによって乾かされた。
 O(An)obl-S(In)-pas 風呂の後、銭湯のオーナーによってドライヤーが乾かされた。
 O(In)obl-S(An)-pas 風呂の後、ドライヤーによって銭湯のオーナーが乾かされた。

- 20 S(An)-O(In)-act デパートの遊び場で、赤ちゃんがおもちゃの車を転がした。
S(In)-O(An)-act デパートの遊び場で、おもちゃの車が赤ちゃんを転がした。
O(An)-S(In)-act デパートの遊び場で、赤ちゃんをおもちゃの車が転がした。
O(In)-S(An)-act デパートの遊び場で、おもちゃの車を赤ちゃんが転がした。
S(An)-O(In)obl-pas デパートの遊び場で、赤ちゃんがおもちゃの車によって
転がされた。
S(In)-O(An)obl-pas デパートの遊び場で、おもちゃの車が赤ちゃんによって
転がされた。
O(An)obl-S(In)-pas デパートの遊び場で、赤ちゃんによっておもちゃの車が
転がされた。
O(In)obl-S(An)-pas デパートの遊び場で、おもちゃの車によって赤ちゃんが
転がされた。
- 21 S(An)-O(In)-act 工事現場で、力持ちの作業員がブルドーザーを持ち上げた。
S(In)-O(An)-act 工事現場で、ブルドーザーが力持ちの作業員を持ち上げた。
O(An)-S(In)-act 工事現場で、力持ちの作業員をブルドーザーが持ち上げた。
O(In)-S(An)-act 工場現場で、ブルドーザーを力持ちの作業員が持ち上げた。
S(An)-O(In)obl-pas 工事現場で、力持ちの作業員がブルドーザーによって
持ち上げられた。
S(In)-O(An)obl-pas 工事現場で、ブルドーザーが力持ちの作業員によって
持ち上げられた。
O(An)obl-S(In)-pas 工事現場で、力持ちの作業員によってブルドーザーが
持ち上げられた。
O(In)obl-S(An)-pas 工事現場で、ブルドーザーによって力持ちの作業員が
持ち上げられた。
- 22 S(An)-O(In)-act 野原で、農夫が土を埋めた。
S(In)-O(An)-act 野原で、土が農夫を埋めた。
O(An)-S(In)-act 野原で、農夫を土が埋めた。
O(In)-S(An)-act 野原で、土を農夫が埋めた。
S(An)-O(In)obl-pas 野原で、農夫が土によって埋められた。
S(In)-O(An)obl-pas 野原で、土が農夫によって埋められた。
O(An)obl-S(In)-pas 野原で、農夫によって土が埋められた。
O(In)obl-S(An)-pas 野原で、土によって農夫が埋められた。
- 23 S(An)-O(In)-act 洗面所で、クリーナーがブラシを掃いた。

- S(In)-O(An)-act 洗面所で、ブラシがクリーナーを掃いた。
O(An)-S(In)-act 洗面所で、クリーナーをブラシが掃いた。
O(In)-S(An)-act 洗面所で、ブラシをクリーナーが掃いた。
S(An)-O(In)obl-pas 洗面所で、クリーナーがブラシによって掃かれた。
S(In)-O(An)obl-pas 洗面所で、ブラシがクリーナーによって掃かれた。
O(An)obl-S(In)-pas 洗面所で、クリーナーによってブラシが掃かれた。
O(In)obl-S(An)-pas 洗面所で、ブラシによってクリーナーが掃かれた。
- 24 S(An)-O(In)-act 政府への反対運動で、指導者が革命を刺激した。
S(In)-O(An)-act 政府への反対運動で、革命が指導者を刺激した。
O(An)-S(In)-act 政府への反対運動で、指導者を革命が刺激した。
O(In)-S(An)-act 政府への反対運動で、革命を指導者が刺激した。
S(An)-O(In)obl-pas 政府への反対運動で、指導者が革命によって刺激された。
S(In)-O(An)obl-pas 政府への反対運動で、革命が指導者によって刺激された。
O(An)obl-S(In)-pas 政府への反対運動で、指導者によって革命が刺激された。
O(In)obl-S(An)-pas 政府への反対運動で、革命によって指導者が刺激された。
- 25 S(An)-O(In)-act 実験中、研究者が危険な液体を溶かした。
S(In)-O(An)-act 実験中、危険な液体が研究者を溶かした。
O(An)-S(In)-act 実験中、研究者を危険な液体が溶かした。
O(In)-S(An)-act 実験中、危険な液体を研究者が溶かした。
S(An)-O(In)obl-pas 実験中、研究者が危険な液体によって溶かされた。
S(In)-O(An)obl-pas 実験中、危険な液体が研究者によって溶かされた。
O(An)obl-S(In)-pas 実験中、研究者によって危険な液体が溶かされた。
O(In)obl-S(An)-pas 実験中、危険な液体によって研究者が溶かされた。
- 26 S(An)-O(In)-act 喫茶店で、ウェイトレスがコーヒーを温めた。
S(In)-O(An)-act 喫茶店で、コーヒーがウェイトレスを温めた。
O(An)-S(In)-act 喫茶店で、ウェイトレスをコーヒーが温めた。
O(In)-S(An)-act 喫茶店で、コーヒーをウェイトレスが温めた。
S(An)-O(In)obl-pas 喫茶店で、ウェイトレスがコーヒーによって温められた。
S(In)-O(An)obl-pas 喫茶店で、コーヒーがウェイトレスによって温められた。
O(An)obl-S(In)-pas 喫茶店で、ウェイトレスによってコーヒーが温められた。
O(In)obl-S(An)-pas 喫茶店で、コーヒーによってウェイトレスが温められた。
- 27 S(An)-O(In)-act 山火事の際、消防員が森を守った。

- S(In)-O(An)-act 山火事の際、森が消防員を守った。
O(An)-S(In)-act 山火事の際、消防員を森が守った。
O(In)-S(An)-act 山火事の際、森を消防員が守った。
S(An)-O(In)obl-pas 山火事の際、消防員が森によって守られた。
S(In)-O(An)obl-pas 山火事の際、森が消防員によって守られた。
O(An)obl-S(In)-pas 山火事の際、消防員によって森が守られた。
O(In)obl-S(An)-pas 山火事の際、森によって消防員が守られた。
- 28 S(An)-O(In)-act 崖から、ロッククライマーが大きな岩を落とした。
S(In)-O(An)-act 崖から、大きな岩がロッククライマーを落とした。
O(An)-S(In)-act 崖から、ロッククライマーを大きな岩が落とした。
O(In)-S(An)-act 崖から、大きな岩をロッククライマーが落とした。
S(An)-O(In)obl-pas 崖から、ロッククライマーが大きな岩によって落とされた。
S(In)-O(An)obl-pas 崖から、大きな岩がロッククライマーによって落とされた。
O(An)obl-S(In)-pas 崖から、ロッククライマーによって大きな岩が落とされた。
O(In)obl-S(An)-pas 崖から、大きな岩によってロッククライマーが落とされた。
- 29 S(An)-O(In)-act 船を引き戻すため、船長がロープを縛った。
S(In)-O(An)-act 船を引き戻すため、ロープが船長を縛った。
O(An)-S(In)-act 船を引き戻すため、船長をロープが縛った。
O(In)-S(An)-act 船を引き戻すため、ロープを船長が縛った。
S(An)-O(In)obl-pas 船を引き戻すため、船長がロープによって縛られた。
S(In)-O(An)obl-pas 船を引き戻すため、ロープが船長によって縛られた。
O(An)obl-S(In)-pas 船を引き戻すため、船長によってロープが縛られた。
O(In)obl-S(An)-pas 船を引き戻すため、ロープによって船長が縛られた。
- 30 S(An)-O(In)-act 空港から、パイロットが管制塔を呼んだ。
S(In)-O(An)-act 空港から、管制塔がパイロットを呼んだ。
O(An)-S(In)-act 空港から、パイロットを管制塔が呼んだ。
O(In)-S(An)-act 空港から、管制塔をパイロットが呼んだ。
S(An)-O(In)obl-pas 空港から、パイロットが管制塔によって呼ばれた。
S(In)-O(An)obl-pas 空港から、管制塔がパイロットによって呼ばれた。
O(An)obl-S(In)-pas 空港から、パイロットによって管制塔が呼ばれた。
O(In)obl-S(An)-pas 空港から、管制塔によってパイロットが呼ばれた。
- 31 S(An)-O(In)-act 駅前で、旅行者がタクシーをひろった。

- S(In)-O(An)-act 駅前で、タクシーが旅行者をひろった。
O(An)-S(In)-act 駅前で、旅行者をタクシーがひろった。
O(In)-S(An)-act 駅前で、タクシーを旅行者がひろった。
S(An)-O(In)obl-pas 駅前で、旅行者がタクシーによってひろわれた。
S(In)-O(An)obl-pas 駅前で、タクシーが旅行者によってひろわれた。
O(An)obl-S(In)-pas 駅前で、旅行者によってタクシーがひろわれた。
O(In)obl-S(An)-pas 駅前で、タクシーによって旅行者がひろわれた。
- 32 S(An)-O(In)-act 川の真中で、海軍軍人が潜水艦を沈めた。
S(In)-O(An)-act 川の真中で、潜水艦が海軍軍人を沈めた。
O(An)-S(In)-act 川の真中で、海軍軍人を潜水艦が沈めた。
O(In)-S(An)-act 川の真中で、潜水艦を海軍軍人が沈めた。
S(An)-O(In)obl-pas 川の真中で、海軍軍人が潜水艦によって沈められた。
S(In)-O(An)obl-pas 川の真中で、潜水艦が海軍軍人によって沈められた。
O(An)obl-S(In)-pas 川の真中で、海軍軍人によって潜水艦が沈められた。
O(In)obl-S(An)-pas 川の真中で、潜水艦によって海軍軍人が沈められた。
- 33 S(An)-O(In)-act 病院の前で、医者が救急車を追いかけた。
S(In)-O(An)-act 病院の前で、救急車が医者を追いかけた。
O(An)-S(In)-act 病院の前で、医者を救急車が追いかけた。
O(In)-S(An)-act 病院の前で、救急車を医者が追いかけた。
S(An)-O(In)obl-pas 病院の前で、医者が救急車によって追いかけられた。
S(In)-O(An)obl-pas 病院の前で、救急車が医者によって追いかけられた。
O(An)obl-S(In)-pas 病院の前で、医者によって救急車が追いかけられた。
O(In)obl-S(An)-pas 病院の前で、救急車によって医者が追いかけられた。
- 34 S(An)-O(In)-act 長年の研究で、科学者がその発見を有名にした。
S(In)-O(An)-act 長年の研究で、その発見が科学者を有名にした。
O(An)-S(In)-act 長年の研究で、科学者をその発見が有名にした。
O(In)-S(An)-act 長年の研究で、その発見を科学者が有名にした。
S(An)-O(In)obl-pas 長年の研究で、科学者がその発見によって有名にされた。
S(In)-O(An)obl-pas 長年の研究で、その発見が科学者によって有名にされた。
O(An)obl-S(In)-pas 長年の研究で、科学者によってその発見が有名にされた。
O(In)obl-S(An)-pas 長年の研究で、その発見によって科学者が有名にされた。
- 35 S(An)-O(In)-act 過去の学業業績により、教授がこの本を誉めた。

- S(In)-O(An)-act 過去の学業業績により、この本が教授を誉めた。
 O(An)-S(In)-act 過去の学業業績により、教授をこの本が誉めた。
 O(In)-S(An)-act 過去の学業業績により、この本を教授が誉めた。
 S(An)-O(In)obl-pas 過去の学業業績により、教授がこの本によって誉められた。
 S(In)-O(An)obl-pas 過去の学業業績により、この本が教授によって誉められた。
 O(An)obl-S(In)-pas 過去の学業業績により、教授によってこの本が誉められた。
 O(In)obl-S(An)-pas 過去の学業業績により、この本によって教授が誉められた。
- 36 S(An)-O(In)-act 戦争中に、軍人が爆弾を爆破した。
 S(In)-O(An)-act 戦争中に、爆弾が軍人を爆破した。
 O(An)-S(In)-act 戦争中に、軍人を爆弾が爆破した。
 O(In)-S(An)-act 戦争中に、爆弾を軍人が爆破した。
 S(An)-O(In)obl-pas 戦争中に、軍人が爆弾によって爆破された。
 S(In)-O(An)obl-pas 戦争中に、爆弾が軍人によって爆破された。
 O(An)obl-S(In)-pas 戦争中に、軍人によって爆弾が爆破された。
 O(In)obl-S(An)-pas 戦争中に、爆弾によって軍人が爆破された。
- 37 S(An)-O(In)-act 宗教の世界の中で、イスラム教徒が聖書を拒絶した。
 S(In)-O(An)-act 宗教の世界の中で、聖書がイスラム教徒を拒絶した。
 O(An)-S(In)-act 宗教の世界の中で、イスラム教徒を聖書が拒絶した。
 O(In)-S(An)-act 宗教の世界の中で、聖書をイスラム教徒が拒絶した。
 S(An)-O(In)obl-pas 宗教の世界の中で、イスラム教徒が聖書によって拒絶された。
 S(In)-O(An)obl-pas 宗教の世界の中で、聖書がイスラム教徒によって拒絶された。
 O(An)obl-S(In)-pas 宗教の世界の中で、イスラム教徒によって聖書が拒絶された。
 O(In)obl-S(An)-pas 宗教の世界の中で、聖書によってイスラム教徒が拒絶された。
- 38 S(An)-O(In)-act 今回の事件で、刑事が調査を妨げた。
 S(In)-O(An)-act 今回の事件で、調査が刑事を妨げた。
 O(An)-S(In)-act 今回の事件で、刑事を調査が妨げた。
 O(In)-S(An)-act 今回の事件で、調査を刑事が妨げた。
 S(An)-O(In)obl-pas 今回の事件で、刑事が調査によって妨げられた。
 S(In)-O(An)obl-pas 今回の事件で、調査が刑事によって妨げられた。
 O(An)obl-S(In)-pas 今回の事件で、刑事によって調査が妨げられた。
 O(In)obl-S(An)-pas 今回の事件で、調査によって刑事が妨げられた。
- 39 S(An)-O(In)-act オフィスで、講師が本棚を押し出した。

- S(In)-O(An)-act オフィスで、本棚が講師を押し出した。
 O(An)-S(In)-act オフィスで、講師を本棚が押し出した。
 O(In)-S(An)-act オフィスで、本棚を講師が押し出した。
 S(An)-O(In)obl-pas オフィスで、講師が本棚によって押し出された。
 S(In)-O(An)obl-pas オフィスで、本棚が講師によって押し出された。
 O(An)obl-S(In)-pas オフィスで、講師によって本棚が押し出された。
 O(In)obl-S(An)-pas オフィスで、本棚によって講師が押し出された。
- 40 S(An)-O(In)-act ガソリンスタンドで、トラックの運転手がバイクを囲んだ。
 S(In)-O(An)-act ガソリンスタンドで、バイクがトラックの運転手を囲んだ。
 O(An)-S(In)-act ガソリンスタンドで、トラックの運転手をバイクが囲んだ。
 O(In)-S(An)-act ガソリンスタンドで、バイクをトラックの運転手が囲んだ。
 S(An)-O(In)obl-pas ガソリンスタンドで、トラックの運転手がバイクによって
 囲まれた。
 S(In)-O(An)obl-pas ガソリンスタンドで、バイクがトラックの運転手によって
 囲まれた。
 O(An)obl-S(In)-pas ガソリンスタンドで、トラックの運転手によってバイクが
 囲まれた。
 O(In)obl-S(An)-pas ガソリンスタンドで、バイクによってトラックの運転手が
 囲まれた。
- 41 S(An)-O(In)-act ビルの火災の際、警備員が最新の設備を救った。
 S(In)-O(An)-act ビルの火災の際、最新の設備が警備員を救った。
 O(An)-S(In)-act ビルの火災の際、警備員を最新の設備が救った。
 O(In)-S(An)-act ビルの火災の際、最新の設備を警備員が救った。
 S(An)-O(In)obl-pas ビルの火災の際、警備員が最新の設備によって救われた。
 S(In)-O(An)obl-pas ビルの火災の際、最新の設備が警備員によって救われた。
 O(An)obl-S(In)-pas ビルの火災の際、警備員によって最新の設備が救われた。
 O(In)obl-S(An)-pas ビルの火災の際、最新の設備によって警備員が救われた。
- 42 S(An)-O(In)-act デパートで、店長が隠しカメラを写した。
 S(In)-O(An)-act デパートで、隠しカメラが店長を写した。
 O(An)-S(In)-act デパートで、店長を隠しカメラが写した。
 O(In)-S(An)-act デパートで、隠しカメラを店長が写した。
 S(An)-O(In)obl-pas デパートで、店長が隠しカメラによって写された。
 S(In)-O(An)obl-pas デパートで、隠しカメラが店長によって写された。

- O(An)obl-S(In)-pas デパートで、店長によって隠しカメラが写された。
O(In)obl-S(An)-pas デパートで、隠しカメラによって店長が写された。
- 43 S(An)-O(In)-act 美術館で、美術家が銅像を抱えた。
S(In)-O(An)-act 美術館で、銅像が美術家を抱えた。
O(An)-S(In)-act 美術館で、芸術家を銅像が抱えた。
O(In)-S(An)-act 美術館で、銅像を芸術家が抱えた。
S(An)-O(In)obl-pas 美術館で、美術家が銅像によって抱えられた。
S(In)-O(An)obl-pas 美術館で、銅像が美術家によって抱えられた。
O(An)obl-S(In)-pas 美術館で、銅像によって芸術家が抱えられた。
O(In)obl-S(An)-pas 美術館で、芸術家によって銅像が抱えられた。
- 44 S(An)-O(In)-act 今回の選挙運動で、国会議員が新聞を批判した。
S(In)-O(An)-act 今回の選挙運動で、新聞が国会議員を批判した。
O(An)-S(In)-act 今回の選挙運動で、国会議員を新聞が批判した。
O(In)-S(An)-act 今回の選挙運動で、新聞を国会議員が批判した。
S(An)-O(In)obl-pas 今回の選挙運動で、国会議員が新聞によって批判された。
S(In)-O(An)obl-pas 今回の選挙運動で、新聞が国会議員によって批判された。
O(An)obl-S(In)-pas 今回の選挙運動で、国会議員によって新聞が批判された。
O(In)obl-S(An)-pas 今回の選挙運動で、新聞によって国会議員が批判された。
- 45 S(An)-O(In)-act 作業場で、大工が尖った机を傷つけた。
S(In)-O(An)-act 作業場で、尖った机が大工を傷つけた。
O(An)-S(In)-act 作業場で、大工を尖った机が傷つけた。
O(In)-S(An)-act 作業場で、尖った机を大工が傷つけた。
S(An)-O(In)obl-pas 作業場で、大工が尖った机によって傷つけられた。
S(In)-O(An)obl-pas 作業場で、尖った机が大工によって傷つけられた。
O(An)obl-S(In)-pas 作業場で、大工によって尖った机が傷つけられた。
O(In)obl-S(An)-pas 作業場で、尖った机によって大工が傷つけられた。
- 46 S(An)-O(In)-act インターネットで学校を知ってもらうため、
校長先生がホームページを紹介した。
S(In)-O(An)-act インターネットで学校を知ってもらうため、
ホームページが校長先生を紹介した。
O(An)-S(In)-act インターネットで学校を知ってもらうため、
校長先生をホームページが紹介した。

- O(In)-S(An)-act インターネットで学校を知ってもらうため、
ホームページを校長先生が紹介した。
- S(An)-O(In)obl-pas インターネットで学校を知ってもらうため、
校長先生がホームページによって紹介された。
- S(In)-O(An)obl-pas インターネットで学校を知ってもらうため、
ホームページが校長先生によって紹介された。
- O(An)obl-S(In)-pas インターネットで学校を知ってもらうため、
校長先生によってホームページが紹介された。
- O(In)obl-S(An)-pas インターネットで学校を知ってもらうため、
ホームページによって校長先生が紹介された。
- 47 S(An)-O(In)-act 議会での討論により、王様が法律を支持した。
S(In)-O(An)-act 議会での討論により、法律が王様を支持した。
O(An)-S(In)-act 議会での討論により、王様を法律が支持した。
O(In)-S(An)-act 議会での討論により、法律を王様が支持した。
S(An)-O(In)obl-pas 議会での討論により、王様が法律によって支持された。
S(In)-O(An)obl-pas 議会での討論により、法律が王様によって支持された。
O(An)obl-S(In)-pas 議会での討論により、法律によって王様が支持された。
O(In)obl-S(An)-pas 議会での討論により、王様によって法律が支持された。
- 48 S(An)-O(In)-act 大通りで、歩行者がミニバスを追い越した。
S(In)-O(An)-act 大通りで、ミニバスが歩行者を追い越した。
O(An)-S(In)-act 大通りで、歩行者をミニバスが追い越した。
O(In)-S(An)-act 大通りで、ミニバスを歩行者が追い越した。
S(An)-O(In)obl-pas 大通りで、歩行者がミニバスによって追い越された。
S(In)-O(An)obl-pas 大通りで、ミニバスが歩行者によって追い越された。
O(An)obl-S(In)-pas 大通りで、ミニバスによって歩行者が追い越された。
O(In)obl-S(An)-pas 大通りで、歩行者によってミニバスが追い越された。

Appendix 4: Experiment 2 Filler sentences

Filler sentences

- 1 飛行機のなかで、赤ん坊が泣いた。
- 2 閉館時間を過ぎたため、図書館が閉まった。
- 3 幼稚園で、子供たちが騒いだ。
- 4 東京駅から、新幹線が走っている。
- 5 コンサートで、歌手が転んだ。
- 6 いい天気のおかげで、洗濯物が乾いた。
- 7 警察が着くまえに、犯人が逃げた。
- 8 ホテル係員の素早い対応のおかげで、混乱が収まった。
- 9 サッカーの試合中に、選手が倒れた。
- 10 大学の記念会館で、入学式が始まった。
- 11 交通事故のため、サイクリストが死んだ。
- 12 経済の不況から、失業率が増えた。
- 13 動物園で、キリンが眠った。
- 14 ピクニックの間、雨が降った。
- 15 体育館での練習で、バレリーナが踊った。

- 16 開いている窓の近くで、花瓶が落ちた。
- 17 水族館のプールで、イルカが泳いだ。
- 18 毎日夜8時頃に、太陽が沈む。
- 19 駅のプラットフォームで、女子高生が座っていた。
- 20 暖かい気候のなかで、パイナップルが育つ。
- 21 吹雪のなかでも、鳥が飛んだ。
- 22 地震の影響で、塔が倒れた。
- 23 草むらのなかで、バッタが跳ねた。
- 24 魚釣りをしていたときに、糸がからまった。

Appendix 5: Experiment 3 Prime-Target sentences

Abbreviations

An = Animate, In = Inanimate

SOV = Subject-Object-Verb, OSV = Object-Subject-Verb

Prime/Target		Word order		Prime/Target Sentences
Prime	1	a	S(an)O(in)V	スケートの選手がタクシーを押した。
		b	S(in)O(an)V	タクシーがスケートの選手を押した。
		c	O(an)S(in)V	スケートの選手をタクシーが押した。
		d	O(in)S(an)V	タクシーをスケートの選手が押した。
Target	1			戦車が花嫁を踏んだ。
Prime	2	a	S(an)O(in)V	アメフト選手がロープウェーを倒した。
		b	S(in)O(an)V	ロープウェーがアメフト選手を倒した。
		c	O(an)S(in)V	アメフト選手をロープウェーが倒した。
		d	O(in)S(an)V	ロープウェーをアメフト選手が倒した。
Target	2			パトカーが画家を押した。
Prime	3	a	S(an)O(in)V	バレリーナが本棚を揺すった。
		b	S(in)O(an)V	本棚がバレリーナを揺すった。
		c	O(an)S(in)V	バレリーナを本棚が揺すった。
		d	O(in)S(an)V	本棚をバレリーナが揺すった。
Target	3			サッカーボールが柔道家を倒した。
Prime	4	a	S(an)O(in)V	魔女が杖をつついた。
		b	S(in)O(an)V	杖が魔女をつついた。
		c	O(an)S(in)V	魔女を杖がつついた。
		d	O(in)S(an)V	杖を魔女がつついた。
Target	4			スピーカーがカウボーイを揺すった。
Prime	5	a	S(an)O(in)V	料理人が飛行機を運んだ。

		b	S(in)O(an)V	飛行機が料理人を運んだ。
		c	O(an)S(in)V	料理人を飛行機が運んだ。
		d	O(in)S(an)V	飛行機を料理人が運んだ。
Target	5			ドライバーが指揮者をつついた。
Prime	6	a	S(an)O(in)V	泥棒がバスケットボールを落とした。
		b	S(in)O(an)V	バスケットボールが泥棒を落とした。
		c	O(an)S(in)V	泥棒をバスケットボールが落とした。
		d	O(in)S(an)V	バスケットボールを泥棒が落とした。
Target	6			消防車がアイスホッケーの選手を踏んだ。
Prime	7	a	S(an)O(in)V	医者が救急車を追った。
		b	S(in)O(an)V	救急車が医者を追った。
		c	O(an)S(in)V	医者を救急車が追った。
		d	O(in)S(an)V	救急車を医者が追った。
Target	7			タイヤが警察官を落とした。
Prime	8	a	S(an)O(in)V	王様がショベルカーを引っ張った。
		b	S(in)O(an)V	ショベルカーが王様を引っ張った。
		c	O(an)S(in)V	王様をショベルカーが引っ張った。
		d	O(in)S(an)V	ショベルカーを王様が引っ張った。
Target	8			バイクが宇宙飛行士を追った。
Prime	9	a	S(an)O(in)V	野球選手がバットを叩いた。
		b	S(in)O(an)V	バットが野球選手を叩いた。
		c	O(an)S(in)V	野球選手をバットが叩いた。
		d	O(in)S(an)V	バットを野球選手が叩いた。
Target	9			潜水艦がギターリストを引っ張った。
Prime	10	a	S(an)O(in)V	漁師が船を沈めた。
		b	S(in)O(an)V	船が漁師を沈めた。

		c	O(an)S(in)V	漁師を船が沈めた。
		d	O(in)S(an)V	船を漁師が沈めた。
Target	10			斧がバトミントンの選手を叩いた。
Prime	11	a	S(an)O(in)V	お坊さんがベッドをつぶした。
		b	S(in)O(an)V	ベッドがお坊さんをつぶした。
		c	O(an)S(in)V	お坊さんをベッドがつぶした。
		d	O(in)S(an)V	ベッドをお坊さんがつぶした。
Target	11			ヨットが卓球の選手を沈めた。
Prime	12	a	S(an)O(in)V	スキーの選手がバスを踏んだ。
		b	S(in)O(an)V	バスがスキーの選手を踏んだ。
		c	O(an)S(in)V	スキーの選手をバスが踏んだ。
		d	O(in)S(an)V	バスをスキーの選手が踏んだ。
Target	12			テレビが忍者をつぶした。
Prime	13	a	S(an)O(in)V	相撲取りが車を押した。
		b	S(in)O(an)V	車が相撲取りを押した。
		c	O(an)S(in)V	相撲取りを車が押した。
		d	O(in)S(an)V	車を相撲取りが押した。
Target	13			スケボーがウェイトレスを運んだ。
Prime	14	a	S(an)O(in)V	海賊がブランコを倒した。
		b	S(in)O(an)V	ブランコが海賊を倒した。
		c	O(an)S(in)V	海賊をブランコが倒した。
		d	O(in)S(an)V	ブランコを海賊が倒した。
Target	14			レーシングカーが赤ちゃんを押した。
Prime	15	a	S(an)O(in)V	歌手が冷蔵庫を揺すった。
		b	S(in)O(an)V	冷蔵庫が歌手を揺すった。
		c	O(an)S(in)V	歌手を冷蔵庫が揺すった。

	d	O(in)S(an)V	冷蔵庫を歌手が揺すった。
Target	15		ベルが女王を倒した。
Prime	16	a S(an)O(in)V	テニス選手がハサミをつついた。
		b S(in)O(an)V	ハサミがテニス選手をつついた。
		c O(an)S(in)V	テニス選手をハサミがつついた。
		d O(in)S(an)V	ハサミをテニス選手がつついた。
Target	16		机が軍人を揺すった。
Prime	17	a S(an)O(in)V	消防員がボートを運んだ。
		b S(in)O(an)V	ボートが消防員を運んだ。
		c O(an)S(in)V	消防員をボートが運んだ。
		d O(in)S(an)V	ボートを消防員が運んだ。
Target	17		ペンが剣道の選手をつついた。
Prime	18	a S(an)O(in)V	ボクサーが気球を落とした。
		b S(in)O(an)V	気球がボクサーを落とした。
		c O(an)S(in)V	ボクサーを気球が落とした。
		d O(in)S(an)V	気球をボクサーが落とした。
Target	18		トラックがキャッチャーを運んだ。
Prime	19	a S(an)O(in)V	サッカー選手がヘリコプターを追った。
		b S(in)O(an)V	ヘリコプターがサッカー選手を追った。
		c O(an)S(in)V	サッカー選手をヘリコプターが追った。
		d O(in)S(an)V	ヘリコプターをサッカー選手が追った。
Target	19		ランプがスケボーの選手を落とした。
Prime	20	a S(an)O(in)V	看護婦が釣り竿を引っ張った。
		b S(in)O(an)V	釣り竿が看護婦を引っ張った。
		c O(an)S(in)V	看護婦を釣り竿が引っ張った。
		d O(in)S(an)V	釣り竿を看護婦が引っ張った。

Target	20		宇宙船がランナーを追った。
Prime	21	a S(an)O(in)V	侍がハンマーを叩いた。
		b S(in)O(an)V	ハンマーが侍を叩いた。
		c O(an)S(in)V	侍をハンマーが叩いた。
		d O(in)S(an)V	ハンマーを侍が叩いた。
Target	21		ホースがフェンシングの選手を引っ張った。
Prime	22	a S(an)O(in)V	カメラマンがブルドーザーを沈めた。
		b S(in)O(an)V	ブルドーザーがカメラマンを沈めた。
		c O(an)S(in)V	カメラマンをブルドーザーが沈めた。
		d O(in)S(an)V	ブルドーザーをカメラマンが沈めた。
Target	22		矢がサンタクロースを叩いた。
Prime	23	a S(an)O(in)V	歌舞伎役者が洗濯機をつぶした。
		b S(in)O(an)V	洗濯機が歌舞伎役者をつぶした。
		c O(an)S(in)V	歌舞伎役者を洗濯機がつぶした。
		d O(in)S(an)V	洗濯機を歌舞伎役者がつぶした。
Target	23		電車が人魚姫を沈めた。
Prime	24	a S(an)O(in)V	新聞配達人が自転車を踏んだ。
		b S(in)O(an)V	自転車が新聞配達人を踏んだ。
		c O(an)S(in)V	新聞配達人を自転車が踏んだ。
		d O(in)S(an)V	自転車を新聞配達人が踏んだ。
Target	24		フライパンが騎士をつぶした。

Appendix 6: Experiment 4 Prime-Target sentences

Abbreviations

An = Animate, In = Inanimate

Act = Active, Pas = Passive

Prime/Target		Voice	Prime/Target sentences
Prime	1	a An-In Act	スケートの選手がタクシーを押した。
		b In-An-Act	タクシーがスケートの選手を押した。
		c An-In Pas	スケートの選手がタクシーに押された。
		d In-An-Pas	タクシーがスケートの選手に押された。
Target	1		戦車が花嫁を踏んだ。
Prime	2	a An-In Act	アメフト選手がロープウェーを倒した。
		b In-An-Act	ロープウェーがアメフト選手を倒した。
		c An-In Pas	アメフト選手がロープウェーに倒された。
		d In-An-Pas	ロープウェーがアメフト選手に倒された。
Target	2		パトカーが画家を押した。
Prime	3	a An-In Act	バレリーナが本棚を揺すった。
		b In-An-Act	本棚がバレリーナを揺すった。
		c An-In Pas	バレリーナが本棚に揺すられた。
		d In-An-Pas	本棚がバレリーナに揺すられた。
Target	3		サッカーボールが柔道家を倒した。
Prime	4	a An-In Act	魔女が杖をつついた。
		b In-An-Act	杖が魔女をつついた。
		c An-In Pas	魔女が杖につつかれた。
		d In-An-Pas	杖が魔女につつかれた。
Target	4		スピーカーがカウボーイを揺すった。
Prime	5	a An-In Act	料理人が飛行機を運んだ。

		b	In-An-Act	飛行機が料理人を運んだ。
		c	An-In Pas	料理人が飛行機に運ばれた。
		d	In-An-Pas	飛行機が料理人に運ばれた。
Target	5			ドライバーが指揮者をつついた。
Prime	6	a	An-In Act	泥棒がバスケットボールを落とした。
		b	In-An-Act	バスケットボールが泥棒を落とした。
		c	An-In Pas	泥棒がバスケットボールに落とされた。
		d	In-An-Pas	バスケットボールが泥棒に落とされた。
Target	6			消防車がアイスホッケーの選手を踏んだ。
Prime	7	a	An-In Act	医者が救急車を追った。
		b	In-An-Act	救急車が医者を追った。
		c	An-In Pas	医者が救急車に追われた。
		d	In-An-Pas	救急車が医者に追われた。
Target	7			タイヤが警察官を落とした。
Prime	8	a	An-In Act	王様がショベルカーを引っ張った。
		b	In-An-Act	ショベルカーが王様を引っ張った。
		c	An-In Pas	王様がショベルカーに引っ張られた。
		d	In-An-Pas	ショベルカーが王様に引っ張られた。
Target	8			バイクが宇宙飛行士を追った。
Prime	9	a	An-In Act	野球選手がバットを叩いた。
		b	In-An-Act	バットが野球選手を叩いた。
		c	An-In Pas	野球選手がバットに叩かれた。
		d	In-An-Pas	バットが野球選手に叩かれた。
Target	9			潜水艦がギターリストを引っ張った。
Prime	10	a	An-In Act	漁師が船を沈めた。
		b	In-An-Act	船が漁師を沈めた。

	c	An-In Pas	漁師が船に沈められた。
	d	In-An-Pas	船が漁師に沈められた。
Target	10		斧がバトミントンの選手を叩いた。
Prime	11	a An-In Act	お坊さんがベッドをつぶした。
		b In-An-Act	ベッドがお坊さんをつぶした。
		c An-In Pas	お坊さんがベッドにつぶされた。
		d In-An-Pas	ベッドがお坊さんにつぶされた。
Target	11		ヨットが卓球の選手を沈めた。
Prime	12	a An-In Act	スキーの選手がバスを踏んだ。
		b In-An-Act	バスがスキーの選手を踏んだ。
		c An-In Pas	スキーの選手がバスに踏まれた。
		d In-An-Pas	バスがスキーの選手に踏まれた。
Target	12		テレビが忍者をつぶした。
Prime	13	a An-In Act	相撲取りが車を押した。
		b In-An-Act	車が相撲取りを押した。
		c An-In Pas	相撲取りが車に押された。
		d In-An-Pas	車が相撲取りに押された。
Target	13		スケボーがウェイトレスを運んだ。
Prime	14	a An-In Act	海賊がブランコを倒した。
		b In-An-Act	ブランコが海賊を倒した。
		c An-In Pas	海賊がブランコに倒された。
		d In-An-Pas	ブランコが海賊に倒された。
Target	14		レーシングカーが赤ちゃんを押した。
Prime	15	a An-In Act	歌手が冷蔵庫を揺すった。
		b In-An-Act	冷蔵庫が歌手を揺すった。
		c An-In Pas	歌手が冷蔵庫に揺すられた。

	d	In-An-Pas	冷蔵庫が歌手に揺すられた。
Target	15		ベルが女王を倒した。
Prime	16	a An-In Act	テニス選手がハサミをつついた。
		b In-An-Act	ハサミがテニス選手をつついた。
		c An-In Pas	テニス選手がハサミにつつかれた。
		d In-An-Pas	ハサミがテニス選手につつかれた。
Target	16		机が軍人を揺すった。
Prime	17	a An-In Act	消防員がボートを運んだ。
		b In-An-Act	ボートが消防員を運んだ。
		c An-In Pas	消防員がボートに運ばれた。
		d In-An-Pas	ボートが消防員に運ばれた。
Target	17		ペンが剣道の選手をつついた。
Prime	18	a An-In Act	ボクサーが気球を落とした。
		b In-An-Act	気球がボクサーを落とした。
		c An-In Pas	ボクサーが気球に落とされた。
		d In-An-Pas	気球がボクサーに落とされた。
Target	18		トラックがキャッチャーを運んだ。
Prime	19	a An-In Act	サッカー選手がヘリコプターを追った。
		b In-An-Act	ヘリコプターがサッカー選手を追った。
		c An-In Pas	サッカー選手がヘリコプターに追われた。
		d In-An-Pas	ヘリコプターがサッカー選手に追われた。
Target	19		ランプがスケボーの選手を落とした。
Prime	20	a An-In Act	看護婦が釣り竿を引っ張った。
		b In-An-Act	釣り竿が看護婦を引っ張った。
		c An-In Pas	看護婦が釣り竿に引っ張られた。
		d In-An-Pas	釣り竿が看護婦に引っ張られた。

Target	20		宇宙船がランナーを追った。
Prime	21	a An-In Act	侍がハンマーを叩いた。
		b In-An-Act	ハンマーが侍を叩いた。
		c An-In Pas	侍がハンマーに叩かれた。
		d In-An-Pas	ハンマーが侍に叩かれた。
Target	21		ホースがフェンシングの選手を引っ張った。
Prime	22	a An-In Act	カメラマンがブルドーザーを沈めた。
		b In-An-Act	ブルドーザーがカメラマンを沈めた。
		c An-In Pas	カメラマンがブルドーザーに沈められた。
		d In-An-Pas	ブルドーザーがカメラマンに沈められた。
Target	22		矢がサンタクロースを叩いた。
Prime	23	a An-In Act	歌舞伎役者が洗濯機をつぶした。
		b In-An-Act	洗濯機が歌舞伎役者をつぶした。
		c An-In Pas	歌舞伎役者が洗濯機につぶされた。
		d In-An-Pas	洗濯機が歌舞伎役者につぶされた。
Target	23		電車が人魚姫を沈めた。
Prime	24	a An-In Act	新聞配達人が自転車を踏んだ。
		b In-An-Act	自転車が新聞配達人を踏んだ。
		c An-In Pas	新聞配達人が自転車に踏まれた。
		d In-An-Pas	自転車が新聞配達人に踏まれた。
Target	24		フライパンが騎士をつぶした。

Appendix 7: Experiment 3 and 4 Fillers

Prime/Target			Animacy	Filler sentences
Prime	1	a	Animate-Agent	ボディビルダーが笑った。
	1	b	Inanimate-Agent	卵が割れた。
Target	1	a	Animate-Agent	工事現場人が頷いた。
	1	b	Inanimate-Agent	ドアが開いた。
Prime	2	a	Animate-Agent	天使が歌った。
	2	b	Inanimate-Agent	コップが割れた。
Target	2	a	Animate-Agent	ラグビーの選手が滑った。
	2	b	Inanimate-Agent	双眼鏡が落ちた。
Prime	3	a	Animate-Agent	歯医者が泣いた。
	3	b	Inanimate-Agent	電球が光った。
Target	3	a	Animate-Agent	吸血鬼が泳いだ。
	3	b	Inanimate-Agent	はしごが倒れた。
Prime	4	a	Animate-Agent	スキューバダイバーが寝た。
	4	b	Inanimate-Agent	ビールがこぼれた。
Target	4	a	Animate-Agent	老人が歩いた。
	4	b	Inanimate-Agent	銃が沈んだ。
Prime	5	a	Animate-Agent	チアリーダーが跳んだ。
	5	b	Inanimate-Agent	携帯電話が鳴った。
Target	5	a	Animate-Agent	サーファーが叫んだ。
	5	b	Inanimate-Agent	バナナが浮かんだ。
Prime	6	a	Animate-Agent	ボーリングの選手が走った。
	6	b	Inanimate-Agent	モップが濡れた。

Target	6	a	Animate-Agent	インディアンが踊った。
	6	b	Inanimate-Agent	レモンが転がった。
Prime	7	a	Animate-Agent	探偵が頷いた。
	7	b	Inanimate-Agent	電子レンジが開いた。
Target	7	a	Animate-Agent	僧侶が走った。
	7	b	Inanimate-Agent	スポンジが濡れた。
Prime	8	a	Animate-Agent	郵便配達人が滑った。
	8	b	Inanimate-Agent	爆弾が落ちた。
Target	8	a	Animate-Agent	スカイダイバーが跳んだ。
	8	b	Inanimate-Agent	目覚まし時計が鳴った。
Prime	9	a	Animate-Agent	科学者が泳いだ。
	9	b	Inanimate-Agent	塔が倒れた。
Target	9	a	Animate-Agent	裁判官が寝た。
	9	b	Inanimate-Agent	コーヒーがこぼれた。
Prime	10	a	Animate-Agent	狩人が歩いた。
	10	b	Inanimate-Agent	ドライヤーが沈んだ。
Target	10	a	Animate-Agent	ミイラが泣いた。
	10	b	Inanimate-Agent	懐中電灯が光った。
Prime	11	a	Animate-Agent	ドラマーが叫んだ。
	11	b	Inanimate-Agent	下駄が浮かんた。
Target	11	a	Animate-Agent	ピアニストが歌った。
	11	b	Inanimate-Agent	傘が壊れた。
Prime	12	a	Animate-Agent	体操選手が踊った。
	12	b	Inanimate-Agent	イチゴが転がった。

Target	12	a	Animate-Agent	先生が笑った。
	12	b	Inanimate-Agent	鍋が壊れた。
Prime	13	a	Animate-Agent	美容師が笑った。
	13	b	Inanimate-Agent	ポットが壊れた。
Target	13	a	Animate-Agent	登山者が歌った。
	13	b	Inanimate-Agent	皿が割れた。
Prime	14	a	Animate-Agent	ゴルフの選手が泣いた。
	14	b	Inanimate-Agent	ナイフが光った。
Target	14	a	Animate-Agent	操縦士が寝た。
	14	b	Inanimate-Agent	ワインがこぼれた。
Prime	15	a	Animate-Agent	バレーボールの選手が跳んだ。
	15	b	Inanimate-Agent	公衆電話が鳴った。
Target	15	a	Animate-Agent	レポーターが走った。
	15	b	Inanimate-Agent	タオルが濡れた。
Prime	16	a	Animate-Agent	ウェイトリフティングの選手が領いた。
	16	b	Inanimate-Agent	窓が開いた。
Target	16	a	Animate-Agent	ローラースケートの男が滑った。
	16	b	Inanimate-Agent	カメラが落ちた。
Prime	17	a	Animate-Agent	水泳選手が泳いだ。
	17	b	Inanimate-Agent	風車が倒れた。
Target	17	a	Animate-Agent	バスケットボールの選手が歩いた
	17	b	Inanimate-Agent	アイロンが沈んだ。
Prime	18	a	Animate-Agent	ビリヤードの選手が叫んだ。
	18	b	Inanimate-Agent	鍵が浮かんた。

Target	18	a	Animate-Agent	魔術師が踊った。
	18	b	Inanimate-Agent	トマトが転がった。

Appendix 8: Experiment 5 Prime-Target sentences

Abbreviations

An = Animate, In = Inanimate

Act = Active, Pas = Passive

Prime/Target		Voice		Prime sentences
Prime	1	a	An-In Act	The skater pushed the taxi.
		b	In-An-Act	The taxi pushed the skater.
		c	An-In Pas	The skater was pushed by the taxi.
		d	In-An-Pas	The taxi was pushed by the skater.
Target	1			The tank flattened the bride.
Prime	2	a	An-In Act	The American footballer squashed the sky tram.
		b	In-An-Act	The sky tram squashed the American footballer.
		c	An-In Pas	The American footballer was squashed by the sky tram.
		d	In-An-Pas	The sky tram was squashed by the American footballer.
Target	2			The police car pushed the artist.
Prime	3	a	An-In Act	The ballerina shook the bookshelf.
		b	In-An-Act	The bookshelf shook the ballerina.
		c	An-In Pas	The ballerina was shook by the bookshelf.
		d	In-An-Pas	The bookshelf was shook by the ballerina.
Target	3			The football ball struck the judo player.
Prime	4	a	An-In Act	The witch poked the stick.
		b	In-An-Act	The stick poked the witch.
		c	An-In Pas	The witch was poked by the stick.
		d	In-An-Pas	The stick was poked by the witch.
Target	4			The speaker shook the cowboy.
Prime	5	a	An-In Act	The cook carried the airplane.

		b	In-An-Act	The airplane carried the cook.
		c	An-In Pas	The cook was carried by the airplane.
		d	In-An-Pas	The airplane was carried by the cook.
Target	5			The screw driver poked the conductor.
Prime	6	a	An-In Act	The thief knocked the basketball.
		b	In-An-Act	The basketball knocked the thief.
		c	An-In Pas	The thief was knocked by the basketball.
		d	In-An-Pas	The basketball was knocked by the thief.
Target	6			The firetruck flattened the ice hockey player.
Prime	7	a	An-In Act	The doctor chased the ambulance.
		b	In-An-Act	The ambulance chased the doctor.
		c	An-In Pas	The doctor was chased by the ambulance.
		d	In-An-Pas	The ambulance was chased by the doctor.
Target	7			The tyre knocked the policeman.
Prime	8	a	An-In Act	The king dragged the shovel car.
		b	In-An-Act	The shovel car dragged the king.
		c	An-In Pas	The king was dragged by the shovel car.
		d	In-An-Pas	The shovel car was dragged by the king.
Target	8			The motorcycle chased the astronaut.
Prime	9	a	An-In Act	The baseball player hit the bat.
		b	In-An-Act	The bat hit the baseball player.
		c	An-In Pas	The baseball player was hit by the bat.
		d	In-An-Pas	The bat was hit by the baseball player.
Target	9			The submarine dragged the guitarist.
Prime	10	a	An-In Act	The fisherman submerged the boat.
		b	In-An-Act	The boat submerged the fisherman.

		c	An-In Pas	The fisherman was submerged by the boat.
		d	In-An-Pas	The boat was submerged by the fisherman.
Target	10			The ax hit the badminton player.
Prime	11	a	An-In Act	The Buddhist crushed the bed.
		b	In-An-Act	The bed crushed the Buddhist.
		c	An-In Pas	The Buddhist was crushed by the bed.
		d	In-An-Pas	The bed was crushed by the Buddhist.
Target	11			The yacht submerged the ping pong player.
Prime	12	a	An-In Act	The skier flattened the bus.
		b	In-An-Act	The bus flattened the skier.
		c	An-In Pas	The skier was flattened by the bus.
		d	In-An-Pas	The bus was flattened by the skier.
Target	12			The television crushed the ninja.
Prime	13	a	An-In Act	The sumo wrestler pushed the car.
		b	In-An-Act	The car pushed the sumo wrestler.
		c	An-In Pas	The sumo wrestler was pushed by the car.
		d	In-An-Pas	The car was pushed by the sumo wrestler.
Target	13			The skateboard carried the waitress.
Prime	14	a	An-In Act	The pirate squashed the swing.
		b	In-An-Act	The swing squashed the pirate.
		c	An-In Pas	The pirate was squashed by the swing.
		d	In-An-Pas	The swing was squashed by the pirate.
Target	14			The racing car pushed the baby.
Prime	15	a	An-In Act	The singer shook the fridge.
		b	In-An-Act	The fridge shook the singer.
		c	An-In Pas	The singer was shook by the fridge.

		d	In-An-Pas	The fridge was shook by the singer.
Target	15			The bell struck the queen.
Prime	16	a	An-In Act	The tennis player poked the scissors.
		b	In-An-Act	The scissors poked the tennis player.
		c	An-In Pas	The tennis player was poked by the scissors.
		d	In-An-Pas	The scissors was poked by the tennis player.
Target	16			The table shook the soldier.
Prime	17	a	An-In Act	The firefighter carried the boat.
		b	In-An-Act	The boat carried the firefighter.
		c	An-In Pas	The firefighter was carried by the boat.
		d	In-An-Pas	The boat was carried by the firefighter.
Target	17			The pen poked the kendo player.
Prime	18	a	An-In Act	The boxer knocked the balloon.
		b	In-An-Act	The balloon knocked the boxer.
		c	An-In Pas	The boxer was knocked by the balloon.
		d	In-An-Pas	The balloon was knocked by the boxer.
Target	18			The truck carried the catcher.
Prime	19	a	An-In Act	The football player chased the helicopter.
		b	In-An-Act	The helicopter chased the football player.
		c	An-In Pas	The football player was chased by the helicopter.
		d	In-An-Pas	The helicopter was chased by the football player.
Target	19			The lamp knocked the skateboard player.
Prime	20	a	An-In Act	The nurse dragged the fishing rod.
		b	In-An-Act	The fishing rod dragged the nurse.
		c	An-In Pas	The nurse was dragged by the fishing rod.
		d	In-An-Pas	The fishing rod was dragged by the nurse.

Target	20			The space ship chased the runner.
Prime	21	a	An-In Act	The samurai hit the hammer.
		b	In-An-Act	The hammer hit the samurai.
		c	An-In Pas	The samurai was hit by the hammer.
		d	In-An-Pas	The hammer was hit by the samurai.
Target	21			The hose dragged the fencing player.
Prime	22	a	An-In Act	The cameraman submerged the bulldozer.
		b	In-An-Act	The bulldozer submerged the cameraman.
		c	An-In Pas	The cameraman was submerged by the bulldozer.
		d	In-An-Pas	The bulldozer was submerged by the cameraman.
Target	22			The arrow hit the santa claus.
Prime	23	a	An-In Act	The Kabuki performer crushed the washing machine.
		b	In-An-Act	The washing machine crushed the Kabuki performer.
		c	An-In Pas	The Kabuki performer was crushed by the washing machine.
		d	In-An-Pas	The washing machine was crushed by the Kabuki performer.
Target	23			The train submerged the mermaid.
Prime	24	a	An-In Act	The newspaper delivery man flattened the bicycle.
		b	In-An-Act	The bicycle flattened the newspaper delivery man.
		c	An-In Pas	The newspaper delivery man was flattened by the bicycle.
		d	In-An-Pas	The bicycle was flattened by the newspaper delivery man.
Target	24			The frying pan crushed the knight.

Appendix 9: Experiment 5 Fillers

Prime/Target			Animacy	Fillers
Prime	1	a	Animate-Agent	The bodybuilder smiled.
	1	b	Inanimate-Agent	The egg cracked.
Target	1	a	Animate-Agent	The constructor nodded.
	1	b	Inanimate-Agent	The door opened.
Prime	2	a	Animate-Agent	The angel sang.
	2	b	Inanimate-Agent	The glass cracked.
Target	2	a	Animate-Agent	The rugby player slipped.
	2	b	Inanimate-Agent	The binoculars dropped.
Prime	3	a	Animate-Agent	The dentist cried.
	3	b	Inanimate-Agent	The lamp shone.
Target	3	a	Animate-Agent	The vampire swam.
	3	b	Inanimate-Agent	The ladder fell.
Prime	4	a	Animate-Agent	The scuba diver slept.
	4	b	Inanimate-Agent	The beer spilt.
Target	4	a	Animate-Agent	The elderly person walked.
	4	b	Inanimate-Agent	The gun sank.
Prime	5	a	Animate-Agent	The cheerleader jumped.
	5	b	Inanimate-Agent	The mobile phone rang.
Target	5	a	Animate-Agent	The surfer shouted.
	5	b	Inanimate-Agent	The banana floated.
Prime	6	a	Animate-Agent	The bowling player ran.
	6	b	Inanimate-Agent	The mop splashed.
Target	6	a	Animate-Agent	The Indian danced.
	6	b	Inanimate-Agent	The lemon rolled.

Prime	7	a	Animate-Agent	The detective nodded.
	7	b	Inanimate-Agent	The microwave oven opened.
Target	7	a	Animate-Agent	The priest ran.
	7	b	Inanimate-Agent	The sponge splashed.
Prime	8	a	Animate-Agent	The postman slipped.
	8	b	Inanimate-Agent	The bomb descended.
Target	8	a	Animate-Agent	The skydiver jumped.
	8	b	Inanimate-Agent	The alarm clock rang.
Prime	9	a	Animate-Agent	The scientist swam.
	9	b	Inanimate-Agent	The tower fell.
Target	9	a	Animate-Agent	The judge slept.
	9	b	Inanimate-Agent	The coffee spilt.
Prime	10	a	Animate-Agent	The hunter walked.
	10	b	Inanimate-Agent	The hair drier dropped.
Target	10	a	Animate-Agent	The mummy cried.
	10	b	Inanimate-Agent	The flashlight shone.
Prime	11	a	Animate-Agent	The drummer yelled.
	11	b	Inanimate-Agent	The clogs floated.
Target	11	a	Animate-Agent	The pianist sang.
	11	b	Inanimate-Agent	The umbrella broke.
Prime	12	a	Animate-Agent	The gymnast danced.
	12	b	Inanimate-Agent	The strawberry rolled.
Target	12	a	Animate-Agent	The teacher smiled.
	12	b	Inanimate-Agent	The pan broke.

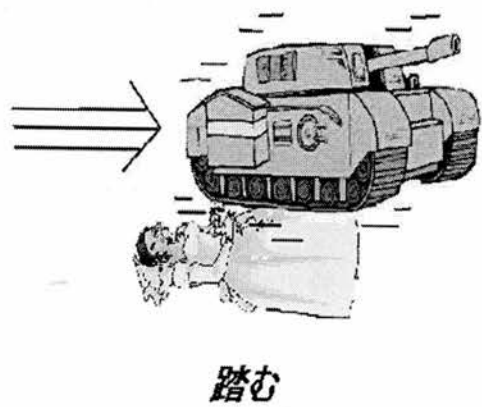
Prime	13	a	Animate-Agent	The beautician smiled.
	13	b	Inanimate-Agent	The teapot broke.
Target	13	a	Animate-Agent	The climber sang.
	13	b	Inanimate-Agent	The plate cracked.
Prime	14	a	Animate-Agent	The golfer cried.
	14	b	Inanimate-Agent	The knife shone.
Target	14	a	Animate-Agent	The pilot slept.
	14	b	Inanimate-Agent	The wine spilt.
Prime	15	a	Animate-Agent	The volleyball player jumped.
	15	b	Inanimate-Agent	The public telephone rang.
Target	15	a	Animate-Agent	The reporter ran.
	15	b	Inanimate-Agent	The towel splashed.
Prime	16	a	Animate-Agent	The weightlifting player nodded.
	16	b	Inanimate-Agent	The window opened.
Target	16	a	Animate-Agent	The roller skater slipped.
	16	b	Inanimate-Agent	The camera dropped.
Prime	17	a	Animate-Agent	The swimmer swam.
	17	b	Inanimate-Agent	The windmill fell.
Target	17	a	Animate-Agent	The basketball player walked.
	17	b	Inanimate-Agent	The iron sank.
Prime	18	a	Animate-Agent	The billiards player yelled.
	18	b	Inanimate-Agent	The key floated.
Target	18	a	Animate-Agent	The magician danced.
	18	b	Inanimate-Agent	The tomato rolled.

Appendix 10: Experiment 3 and 4 – Prime and Target pictures

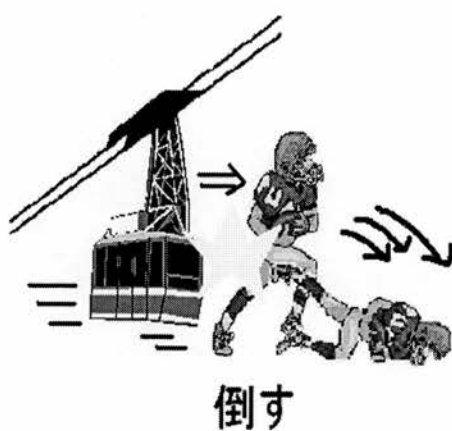
Prime pictures 1.



Target Picture 1.



Prime pictures 2



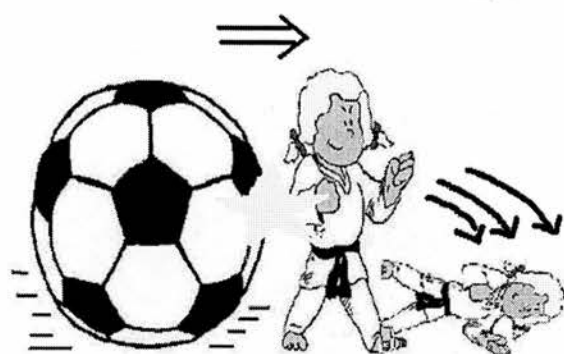
Target picture 2



Prime pictures 3



Target picture 3



倒す

Prime pictures 4

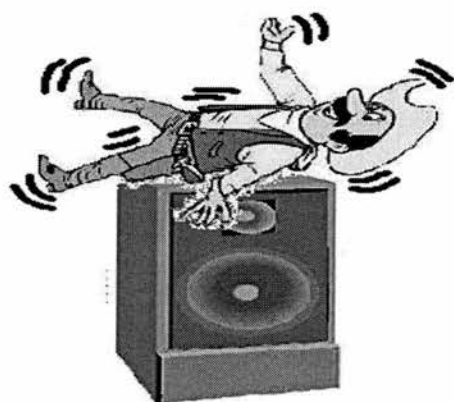


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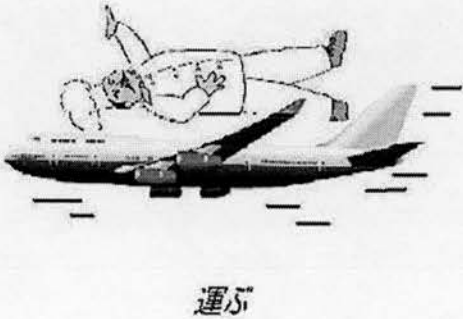
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Target picture 4

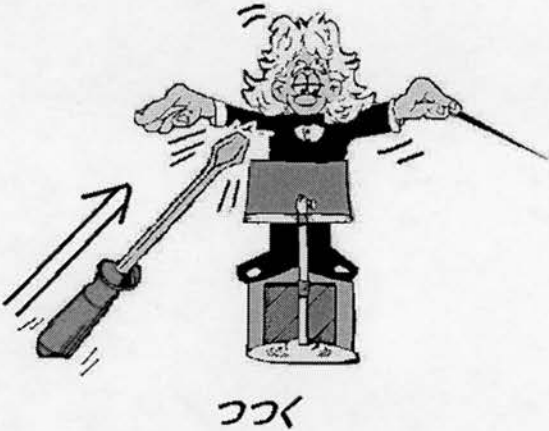


揺する

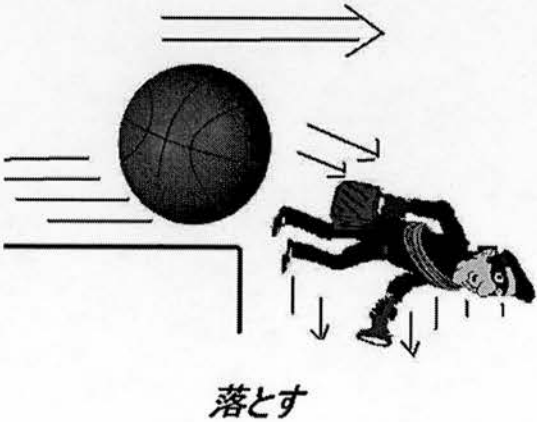
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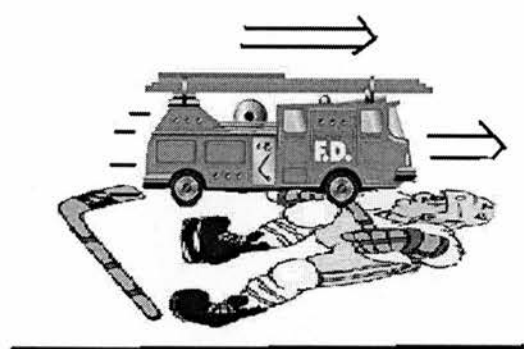
Target picture 5



Prime pictures 6



Target picture 6

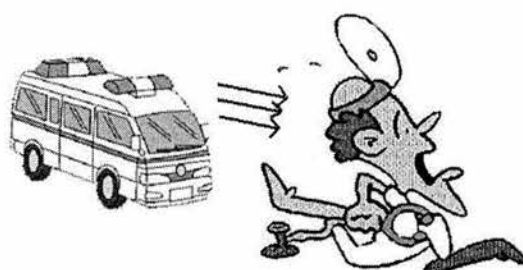


踏む

Prime picture 7

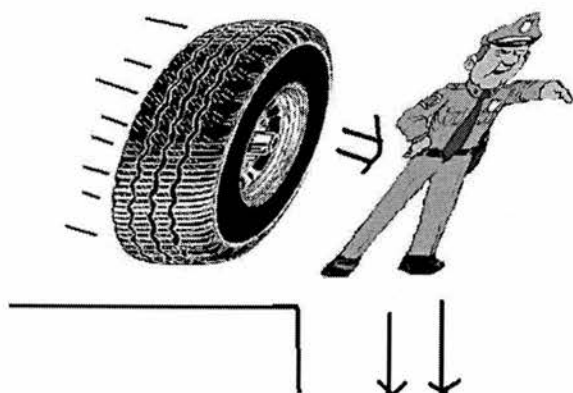


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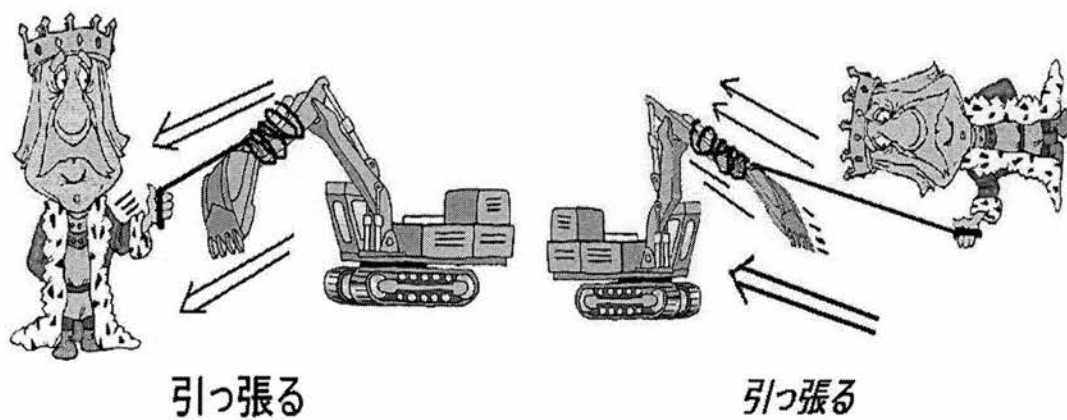
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Target picture 7

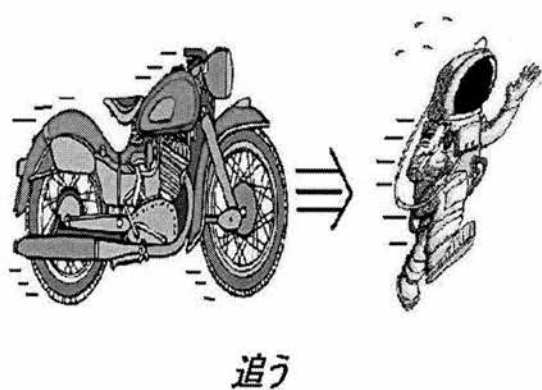


落とす

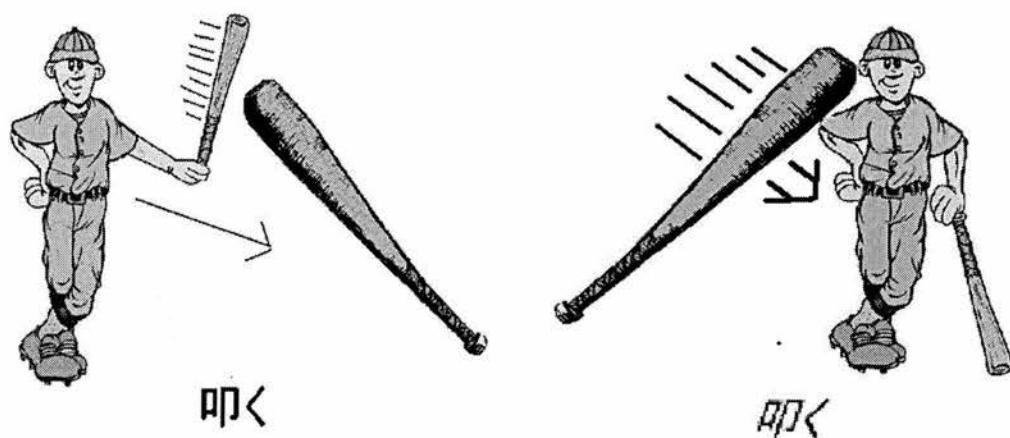
Prime pictures 8



Target picture 8



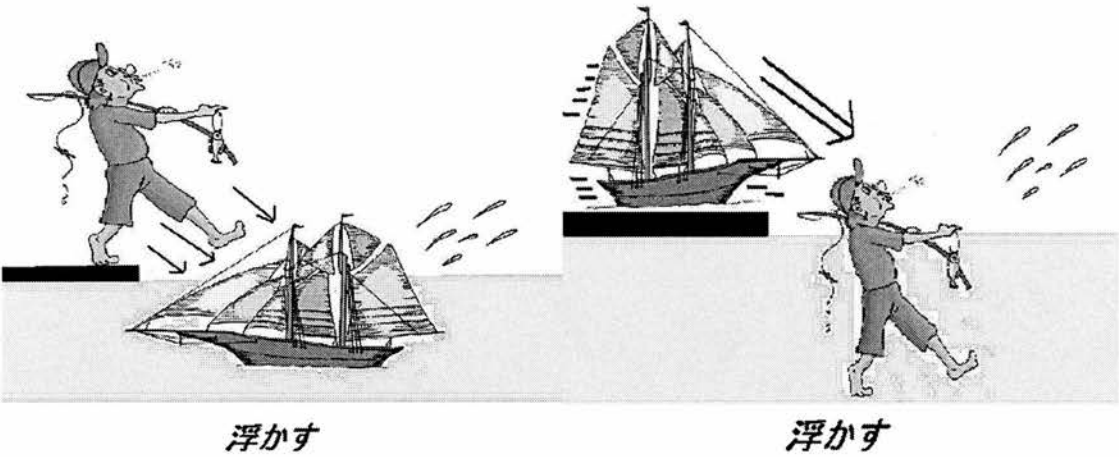
Prime pictures 9



Target picture 9



Prime pictures 10



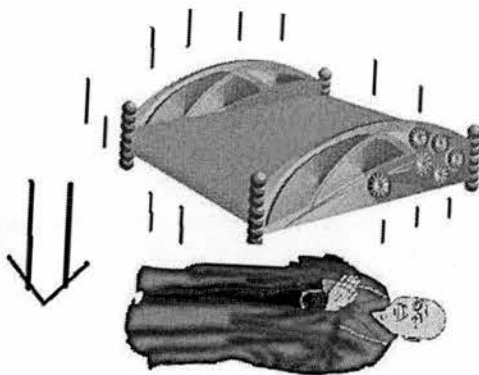
Target picture 10



Prime pictures 11

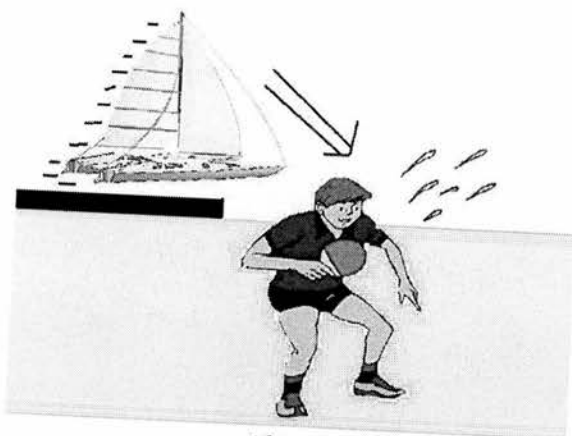


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つぶす

Target picture 11



沈める

Prime pictures 12

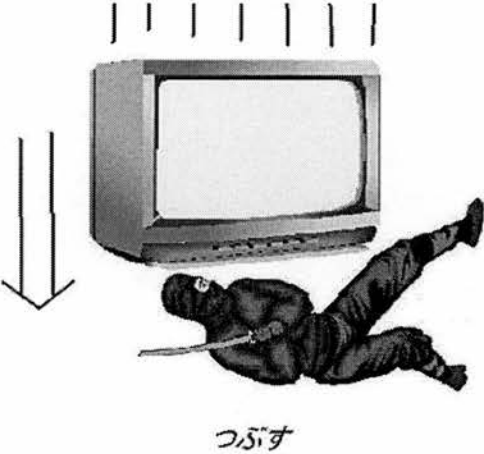


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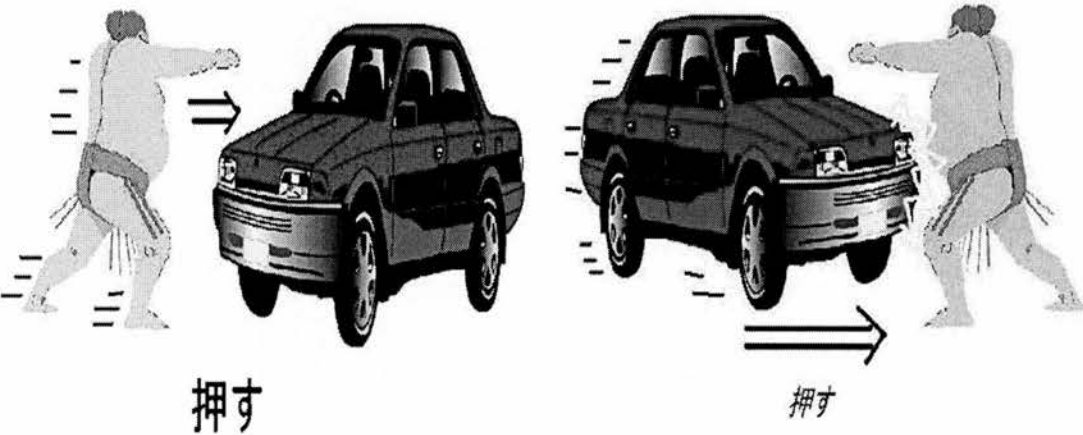


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Target picture 12



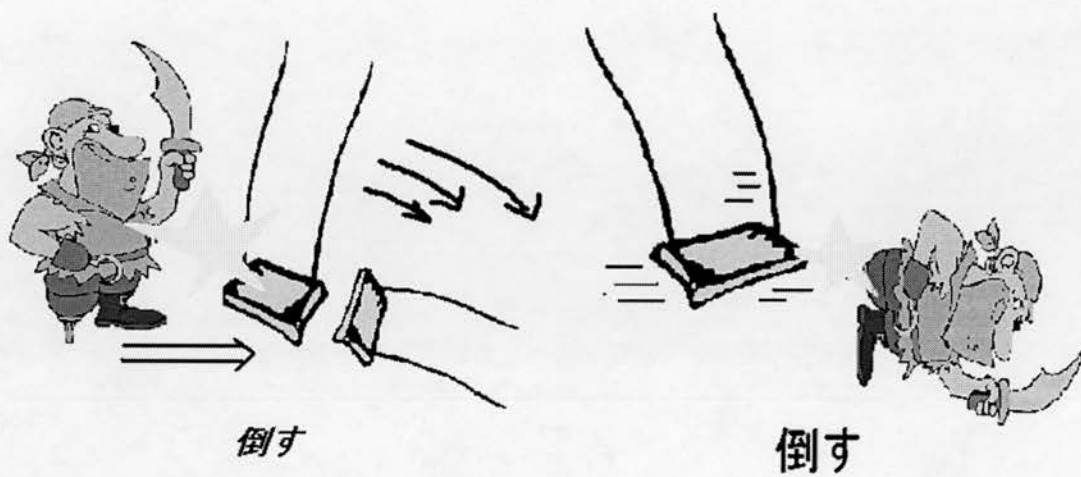
Prime pictures 13



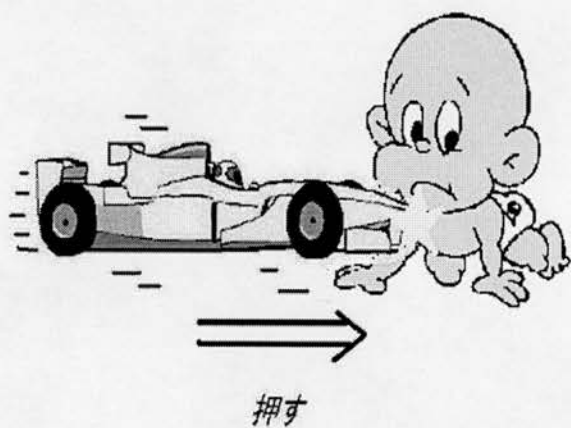
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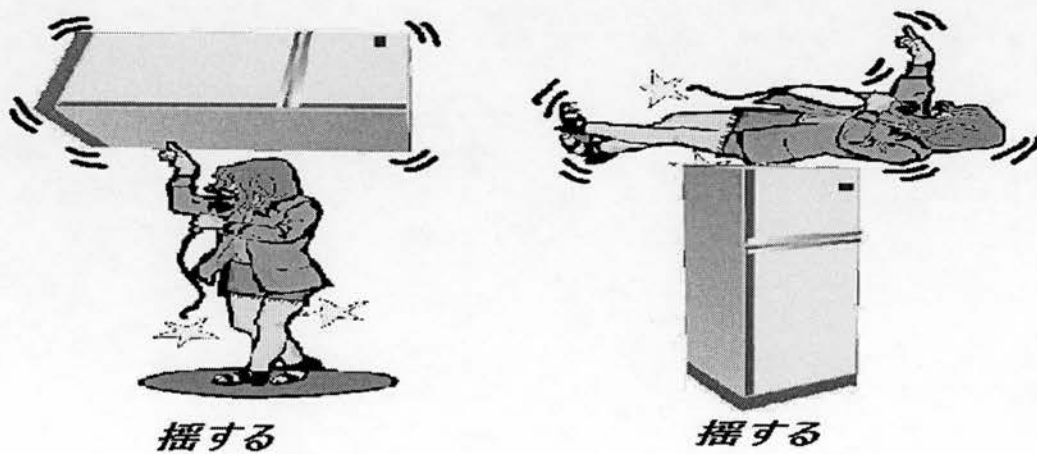
Prime pictures 14



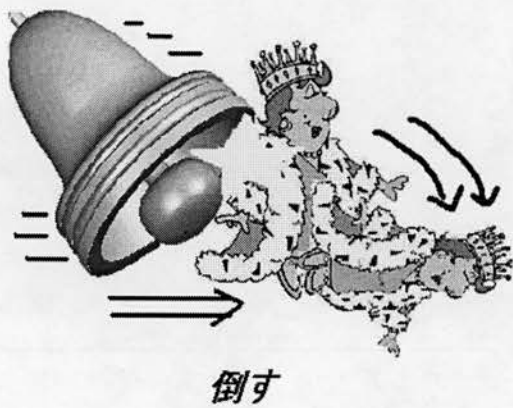
Target picture 14



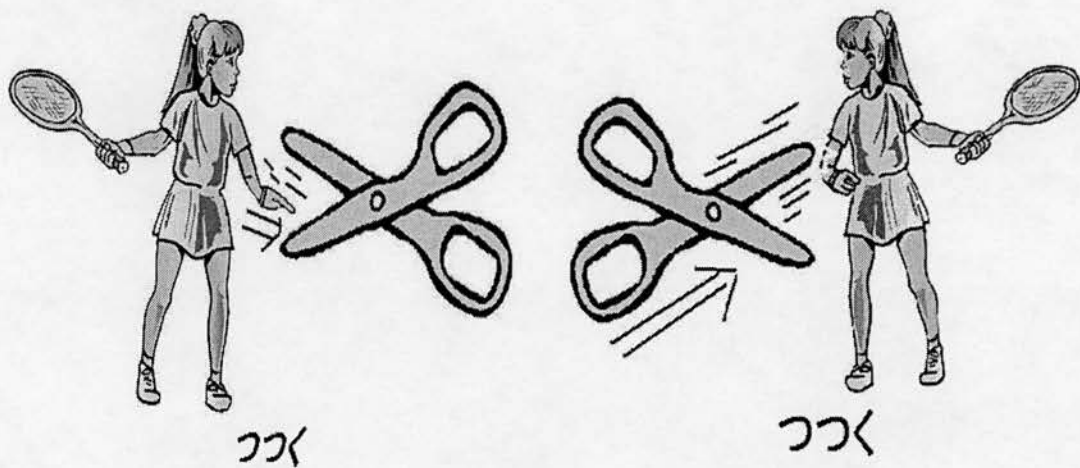
Prime pictures 15



Target picture 15



Prime pictures 16



Target picture16



Prime pictures 17

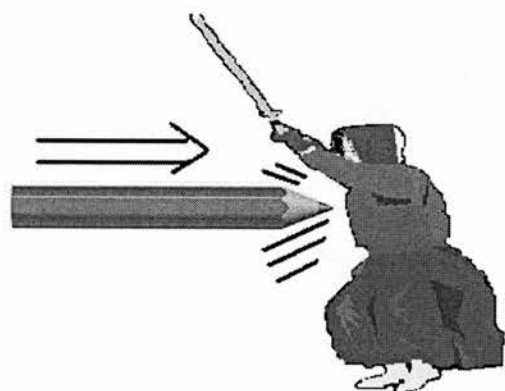


運ぶ



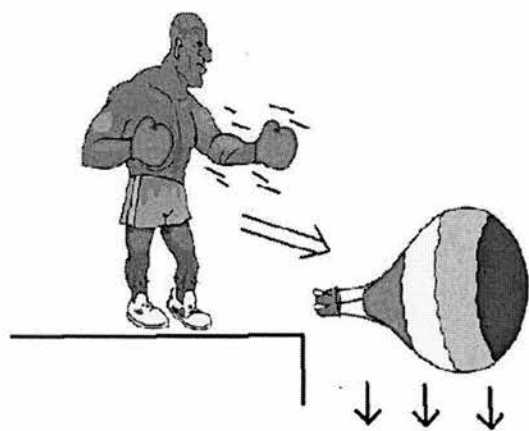
運ぶ

Target picture 17

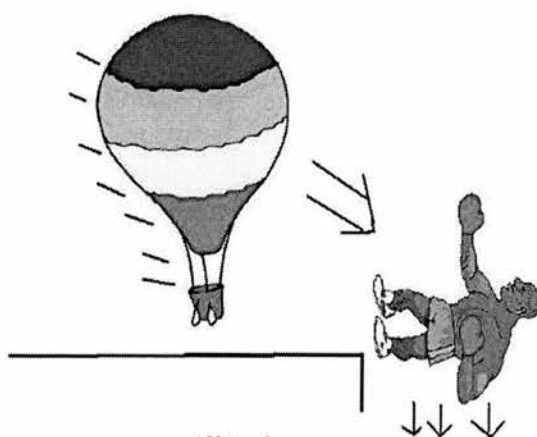


つつく

Prime pictures 18



落とす



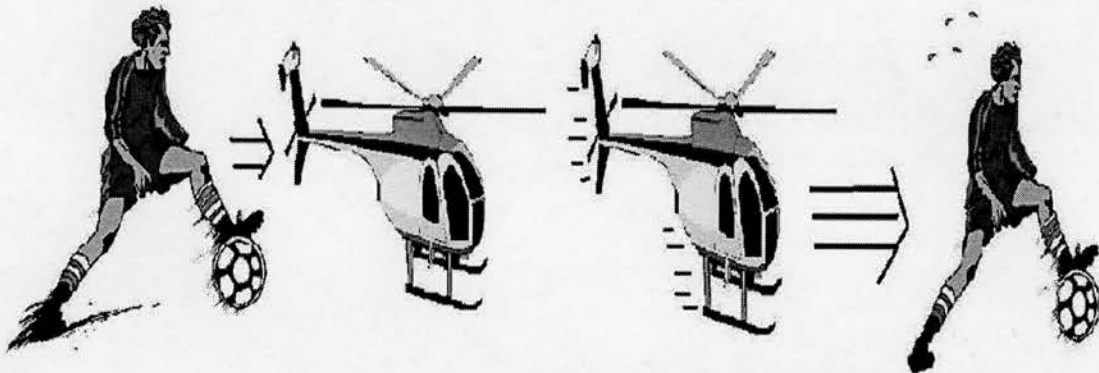
落とす

Target picture 18



運ぶ

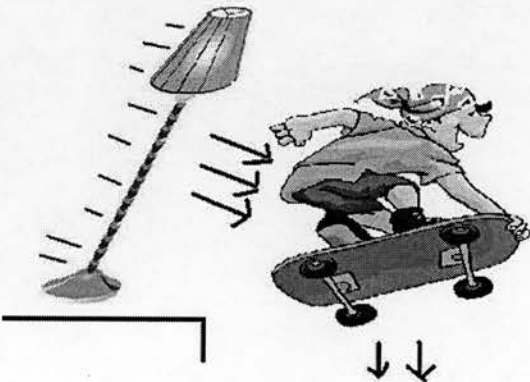
Prime pictures 19



追う

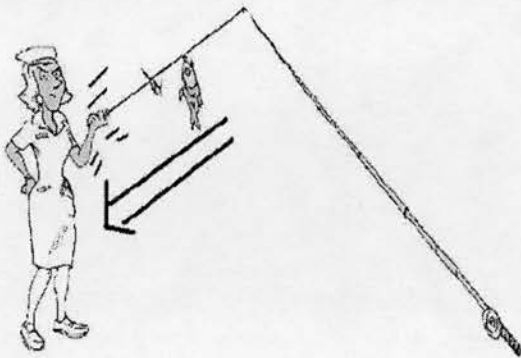
追う

Target picture 19

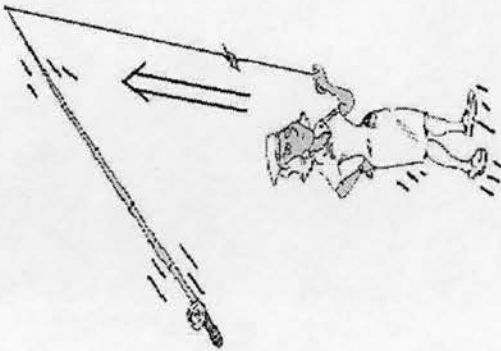


落とす

Prime pictures 20

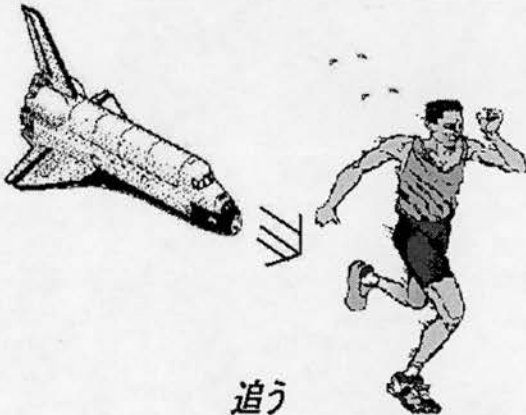


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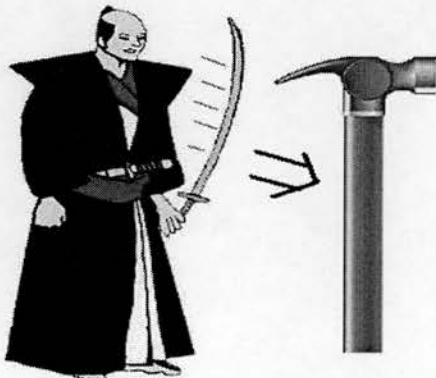
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Target picture 20

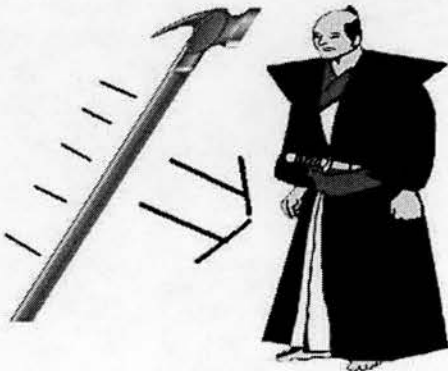


追う

Prime pictures 21

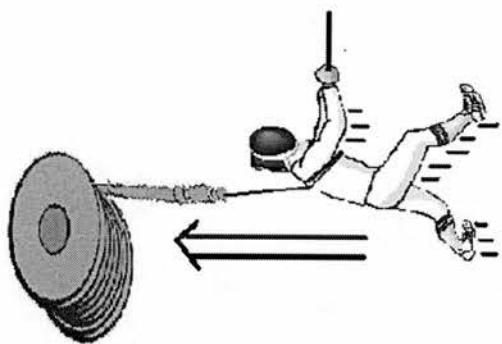


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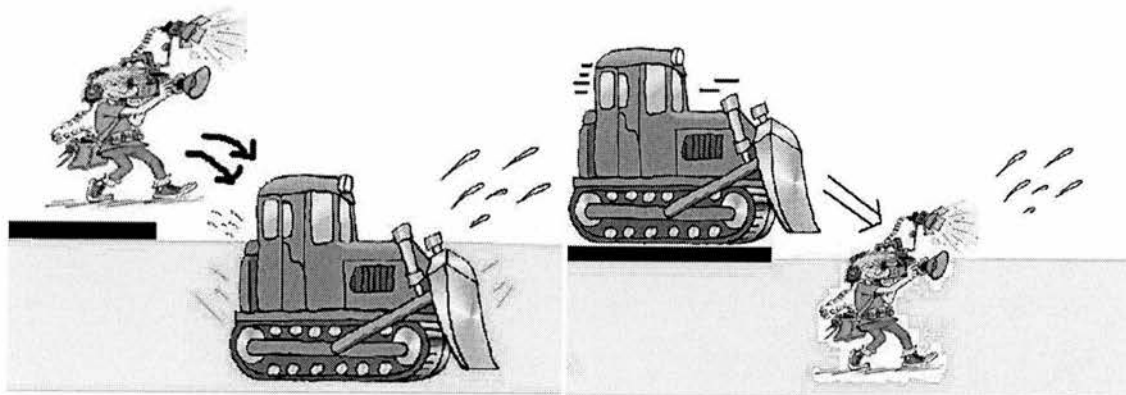
叩く

Target picture 21



引っ張る

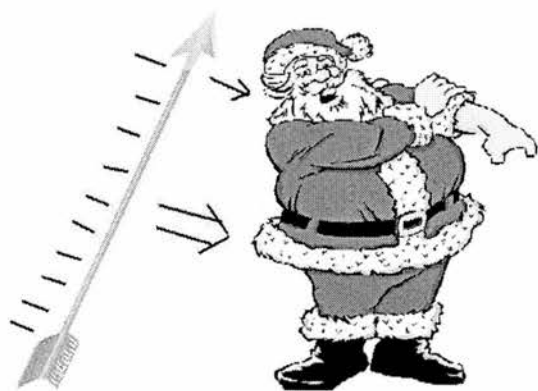
Prime pictures 22



沈める

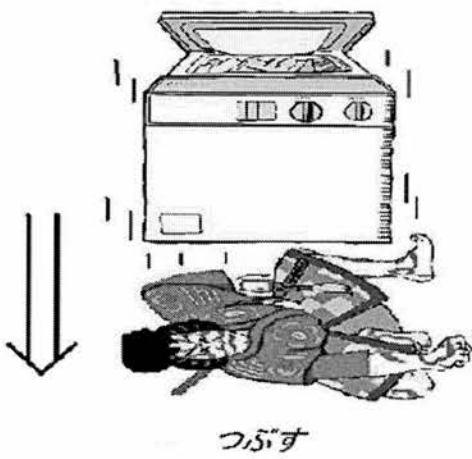
沈める

Target picture 22

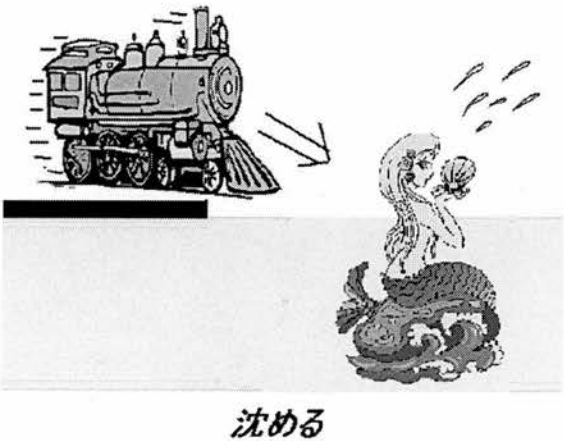


叩く

Prime pictures 23



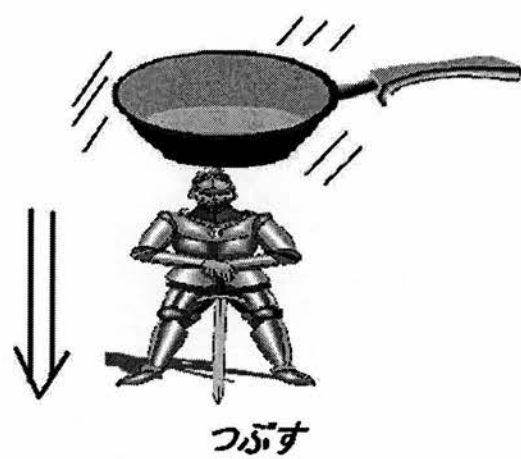
Target picture 23



Prime pictures 24



Target picture 24

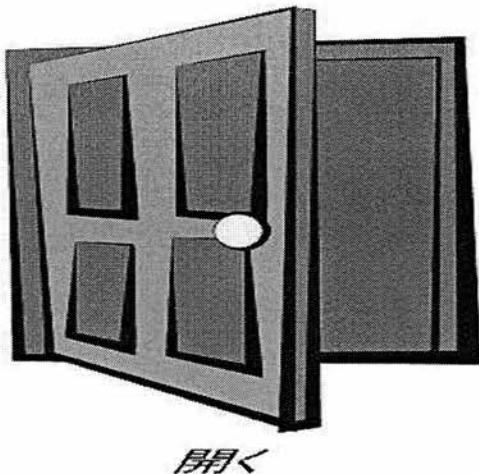


Appendix 11 Experiment 3 and 4 Filler pictures

Prime 1 a - b



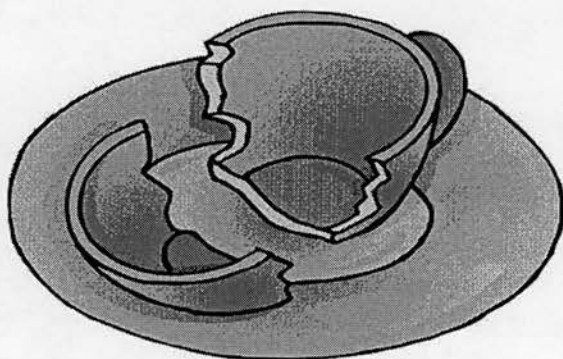
Target 1 a - b



Prime 2 a - b

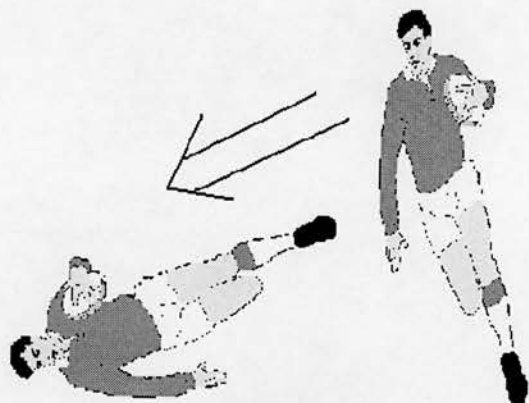


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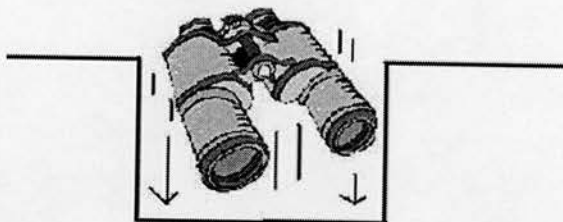


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Target 2 a - b



滑る

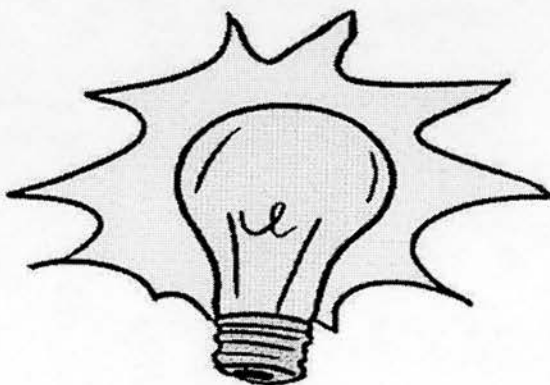


落ちる

Prime 3 a - b

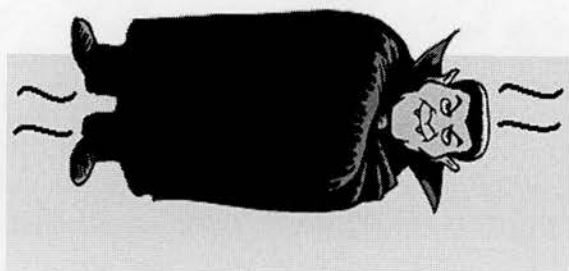


泣く

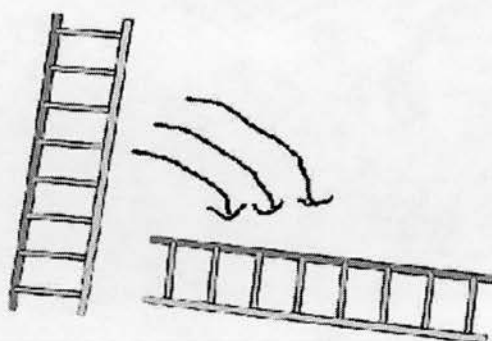


光る

Target 3 a - b



泳ぐ

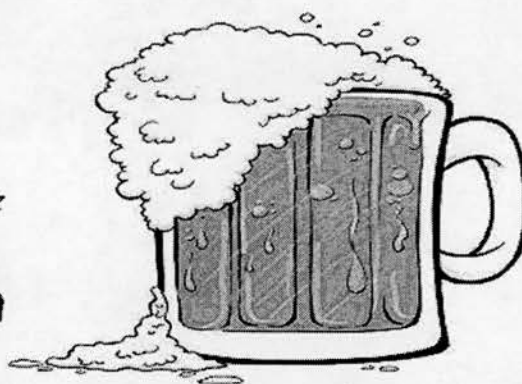


倒れる

Prime 4 a - b



寝る

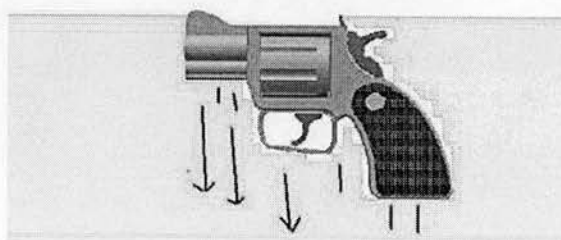


こぼれる

Target 4 a - b



歩く

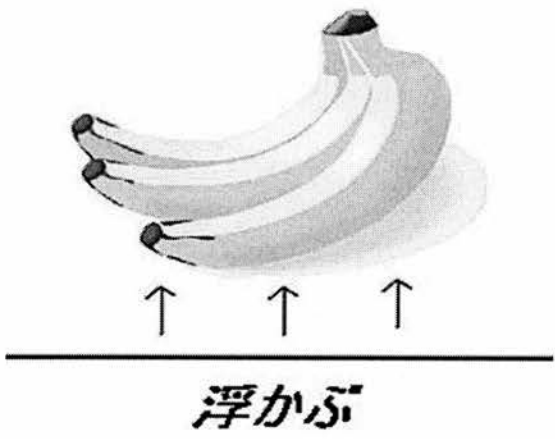


洗む

Prime 5 a - b



Target 5 a - b



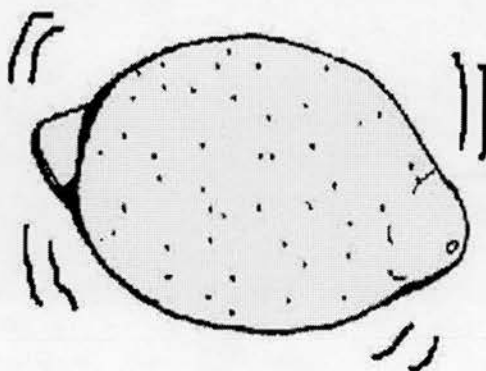
Prime 6 a - b



Target 6 a - b



踊る



転がる

Prime 7 a - b



うなづく

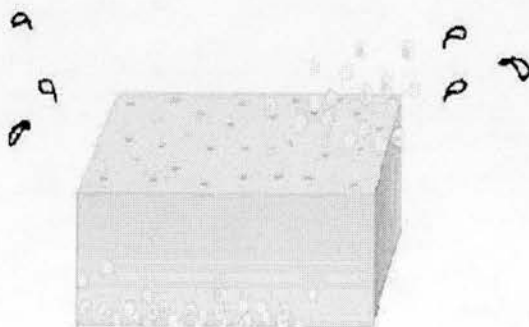


開く

Target 7 a - b

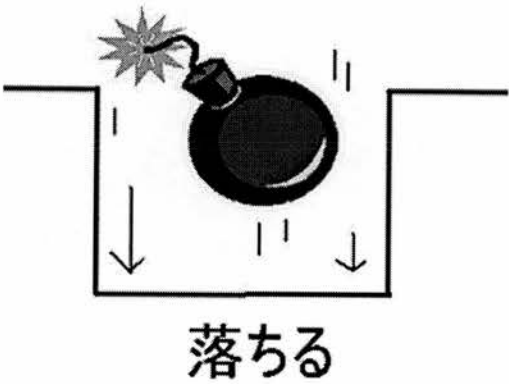


走る

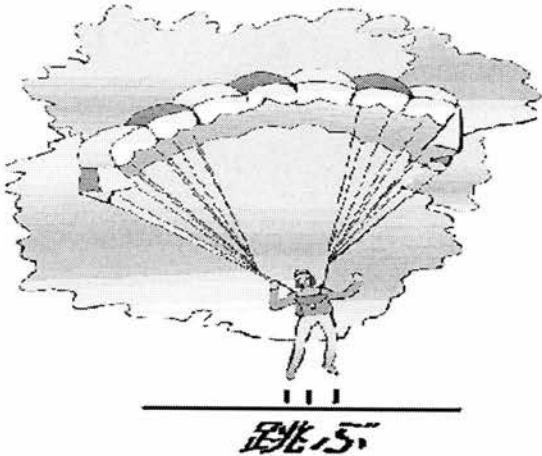


濡れる

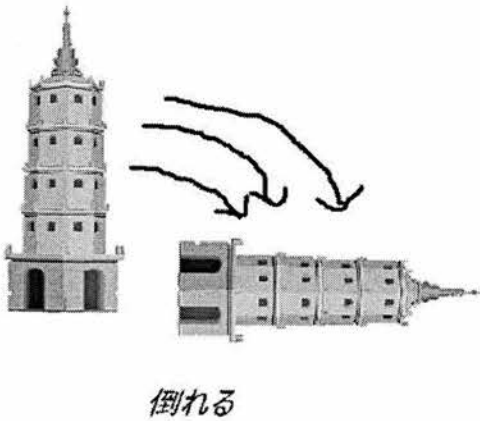
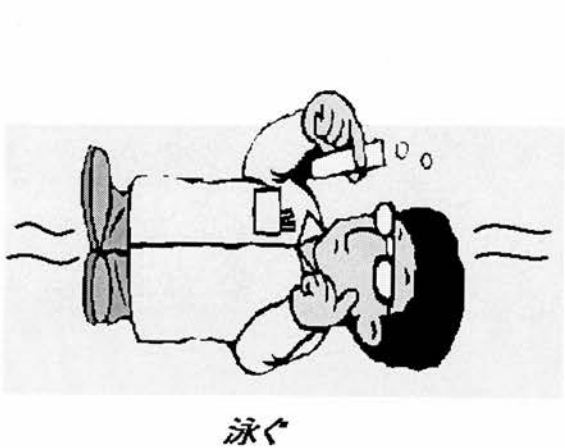
Prime 8 a - b



Target 8 a - b



Prime 9 a - b



Target 9 a - b



寝る

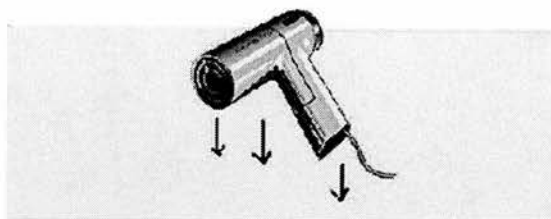


こぼれる

Prime 10 a - b

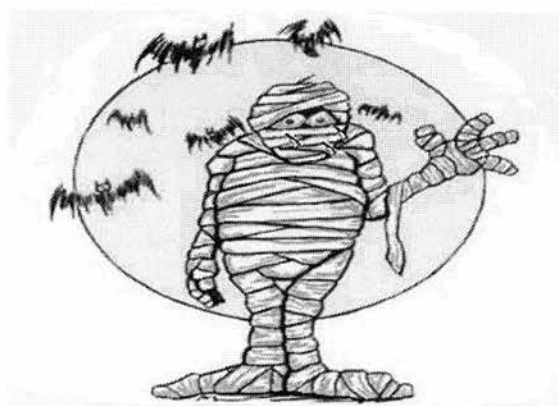


歩く

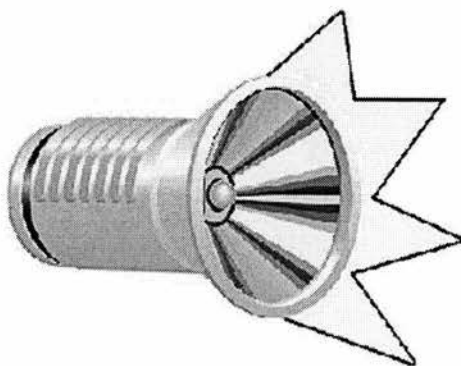


沈む

Target 10 a - b



泣く

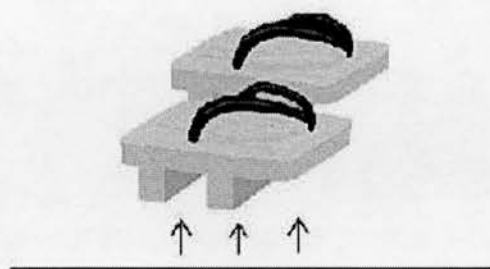


光る

Prime 11 a - b



叫ぶ

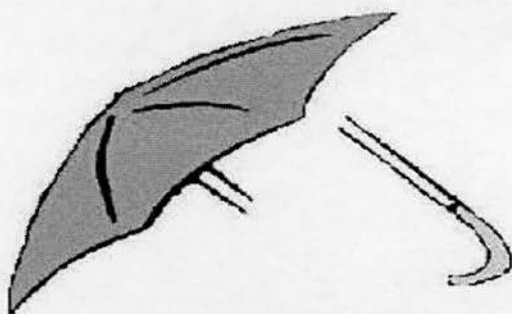


浮かぶ

Target 11 a - b

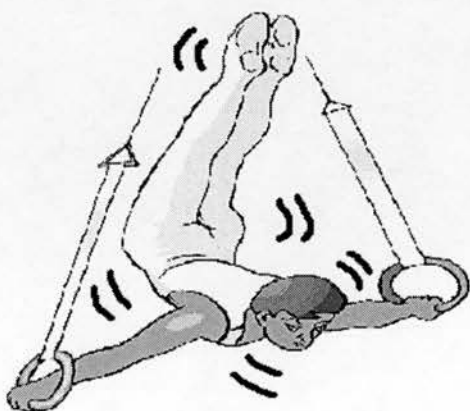


歌う

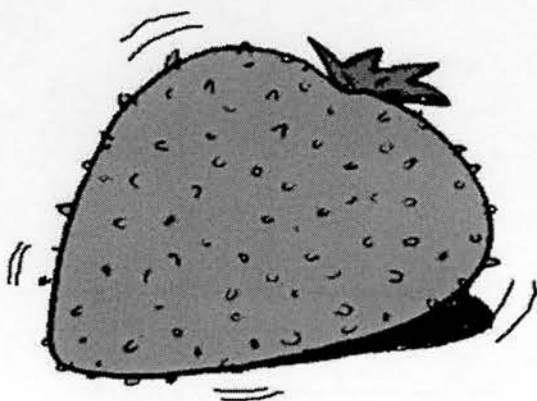


壊れる

Prime 12 a - b



踊る

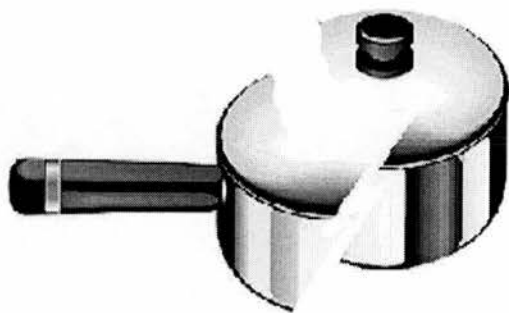


転がる

Target 12 a - b



笑う

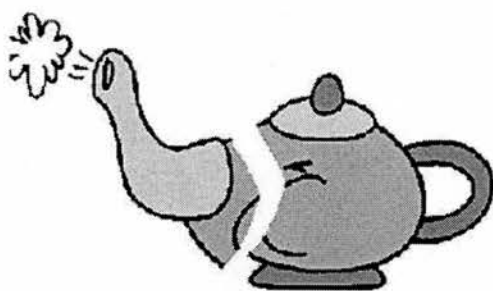


壊れる

Prime 13 a - b



笑う

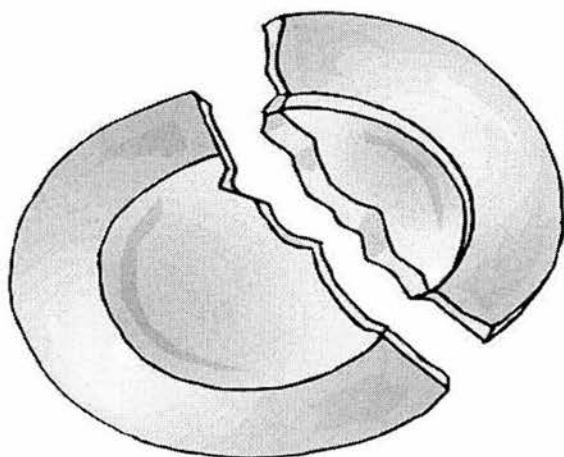


壊れる

Target 13 a - b



歌う

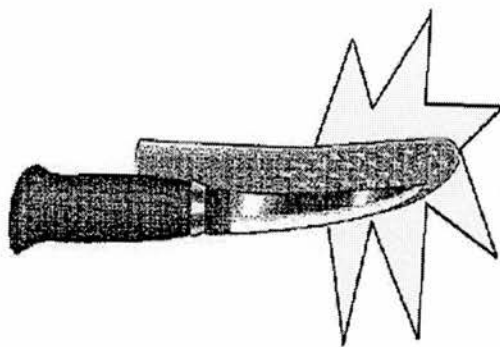


割れる

Prime 14 a - b



泣く



光る

Target 14 a - b



寝る



こぼれる

Prime 15 a - b



跳ぶ



鳴る

Target 15 a - b



走る

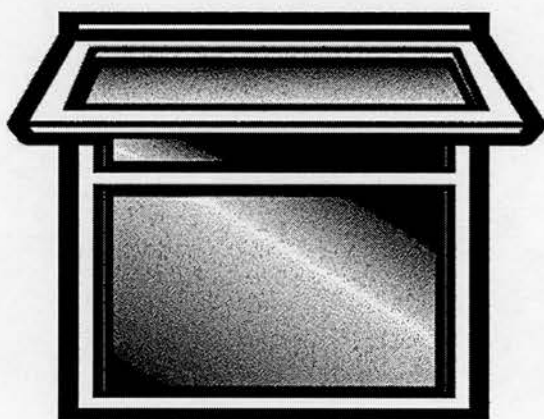


濡れる

Prime 16 a - b



頷く

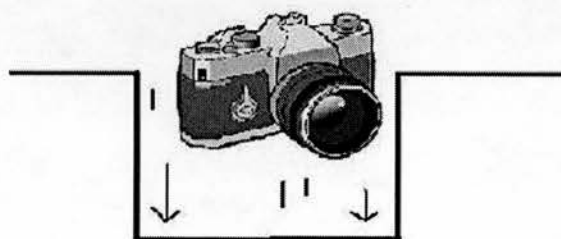


開く

Target 16 a - b



転ぶ

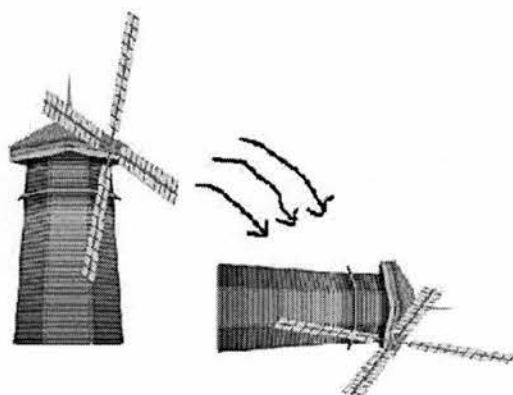


落ちる

Prime 17 a - b



泳ぐ

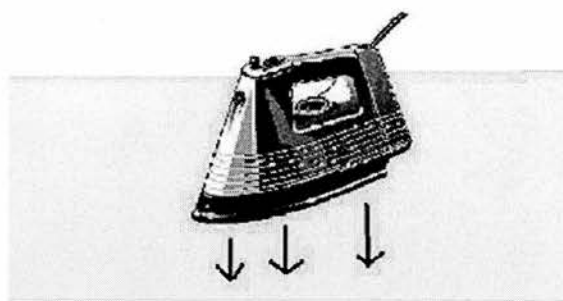


倒れる

Target 17 a - b

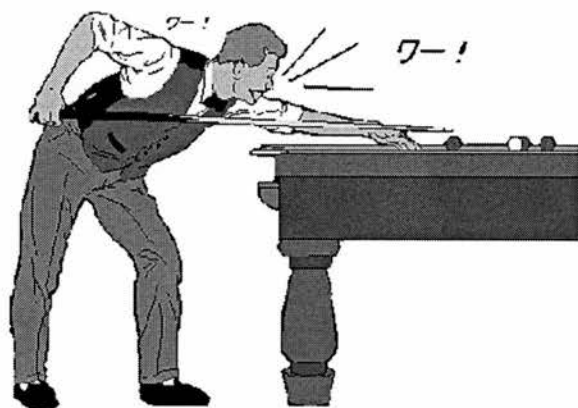


歩く

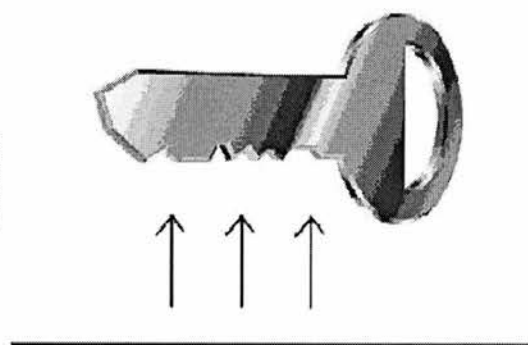


沈む

Prime 18 a - b



叫ぶ



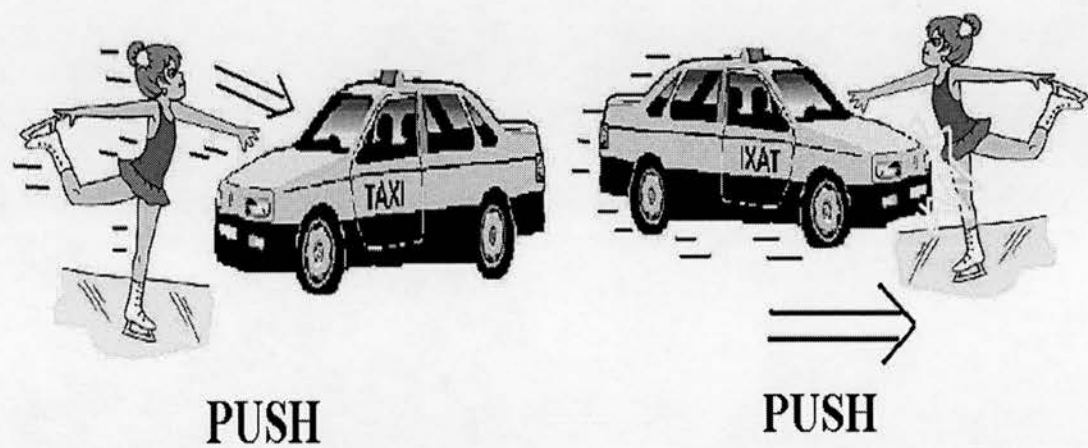
浮かぶ

Target 18 a - b

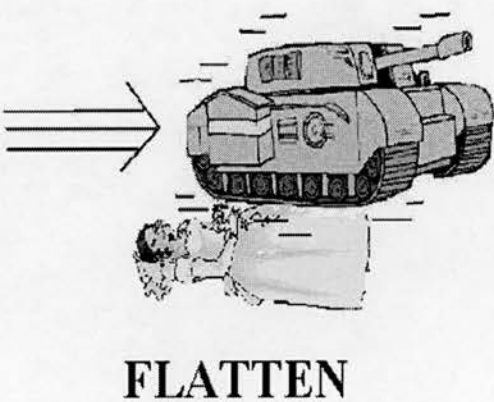


Appendix 12: Experiment 5 Prime and Target pictures

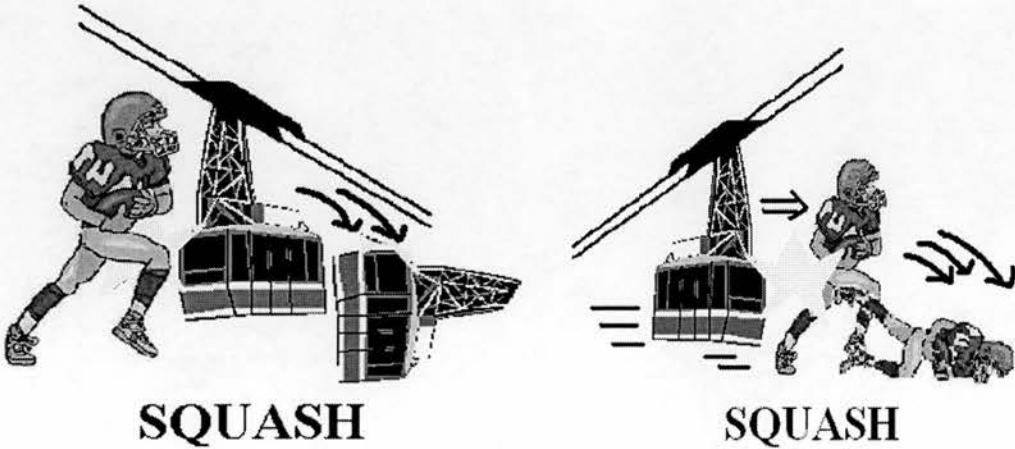
Prime pictures 1



Target picture 1



Prime pictures 2



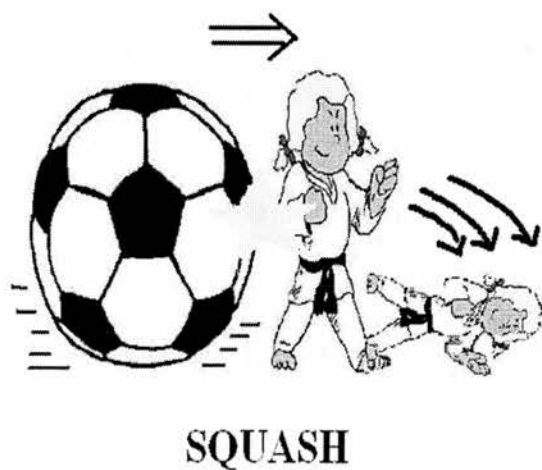
Target picture 2



Prime pictures 3



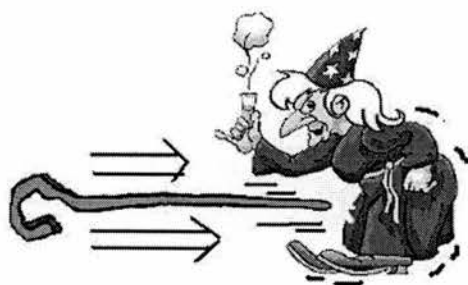
Target picture 3



Prime pictures 4

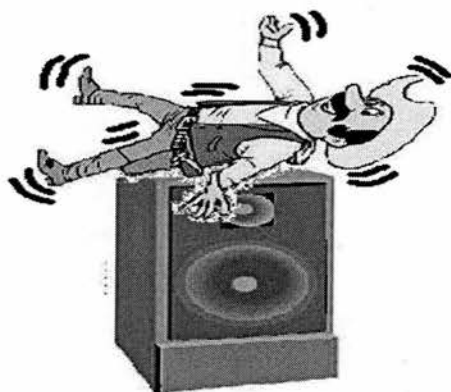


POKE



POKE

Target picture 4

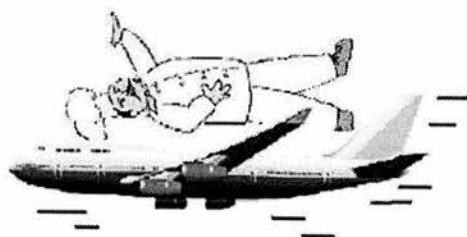


SHAKE

Prime pictures 5



CARRY



CARRY

Target picture 5

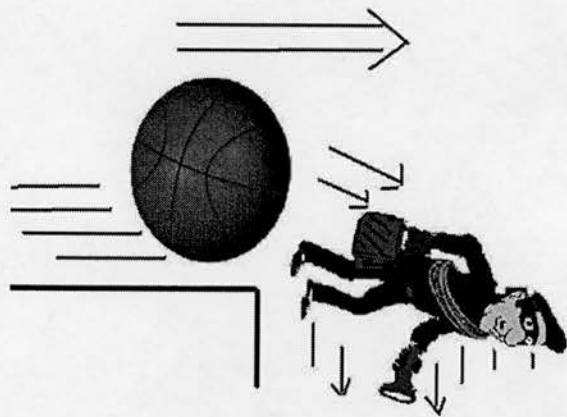


POKE

Prime pictures 6

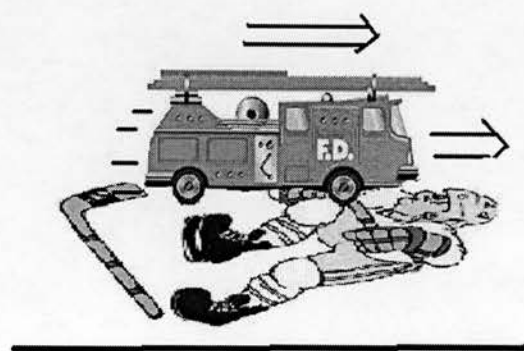


KNOCK



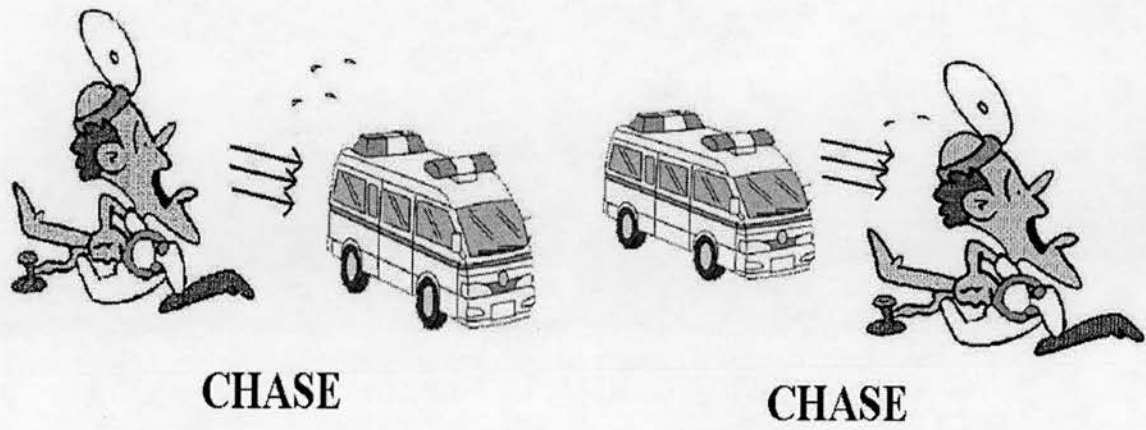
KNOCK

Target picture 6

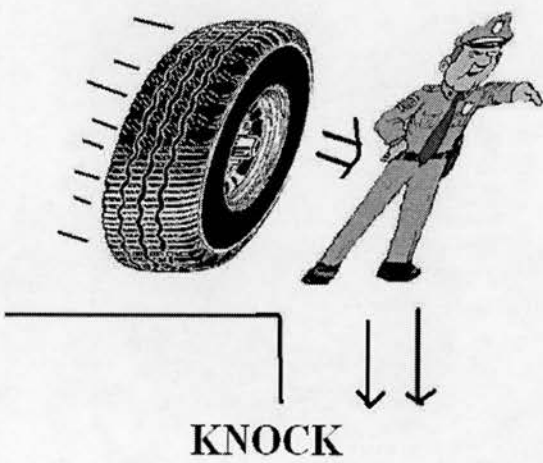


FLATTEN

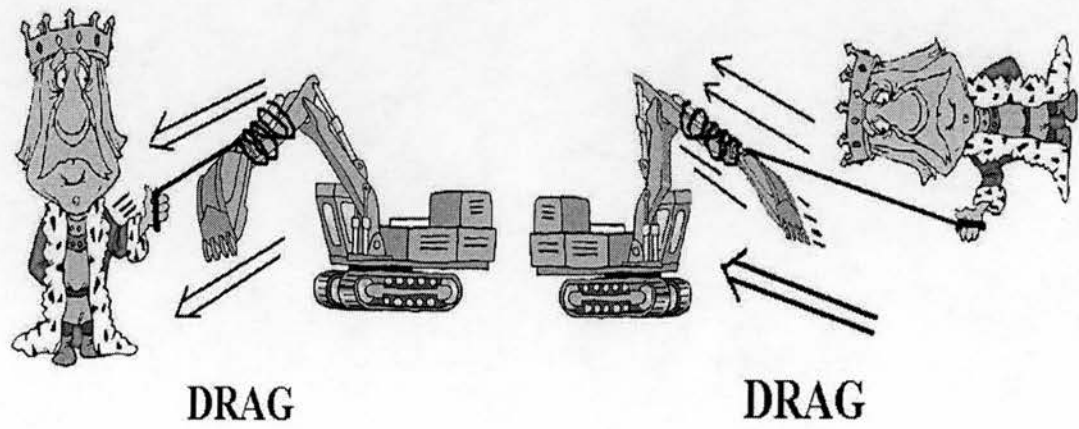
Prime pictures 7



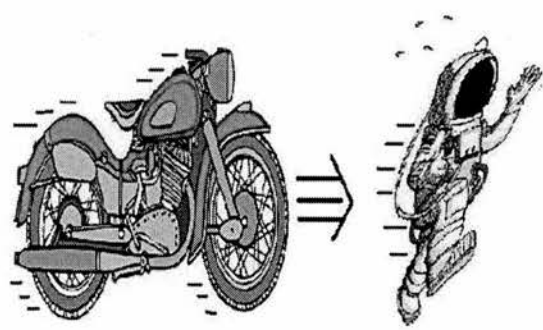
Target picture 7



Prime pictures 8

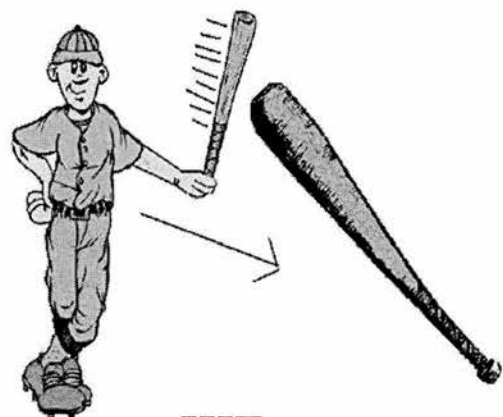


Target picture 8



CHASE

Prime pictures 9



HIT



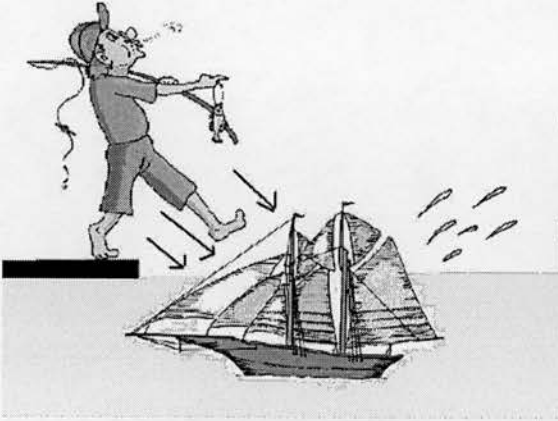
HIT

Target picture 9

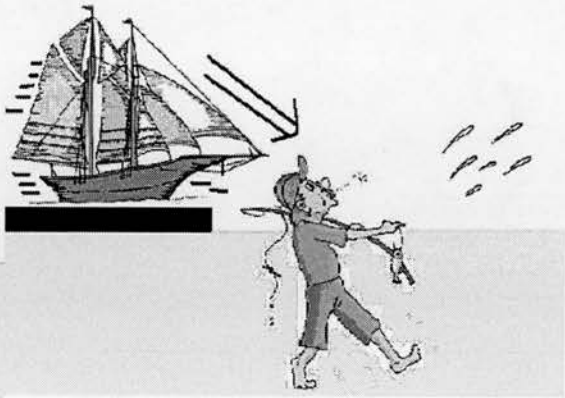


DRAG

Prime pictures 10



SUBMERGE



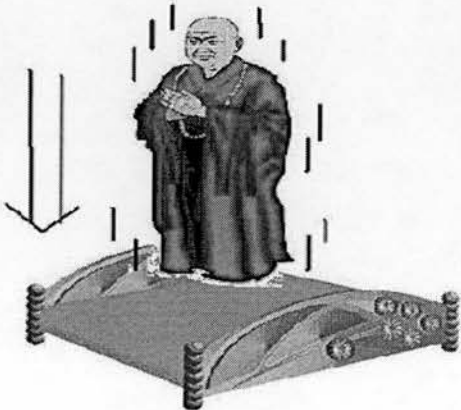
SUBMERGE

Target picture 10

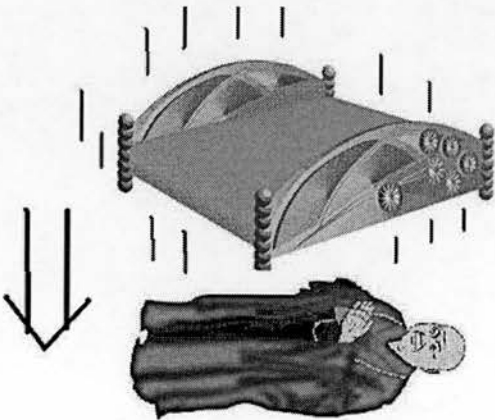


HIT

Prime pictures 11

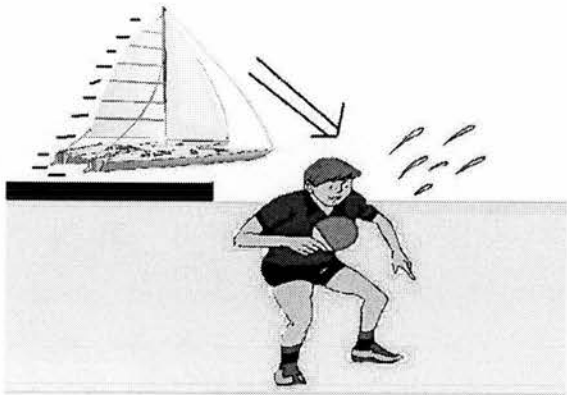


CRUSH



CRUSH

Target picture 11

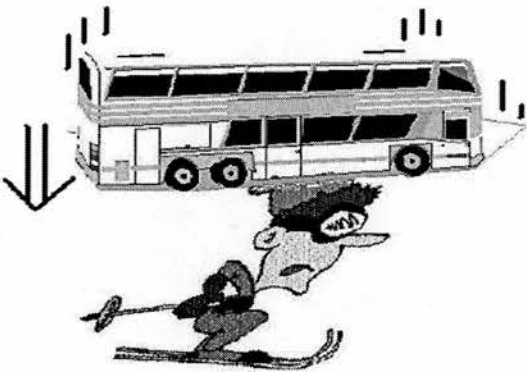


SUBMERGE

Prime pictures 12

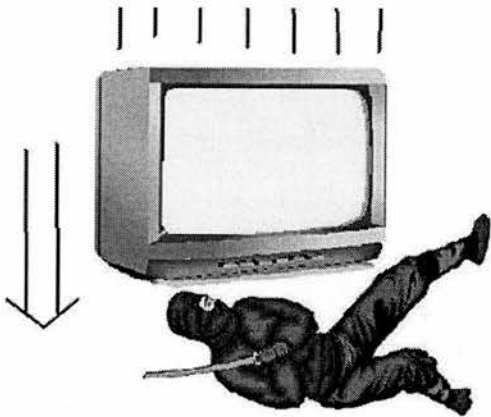


FLATTEN



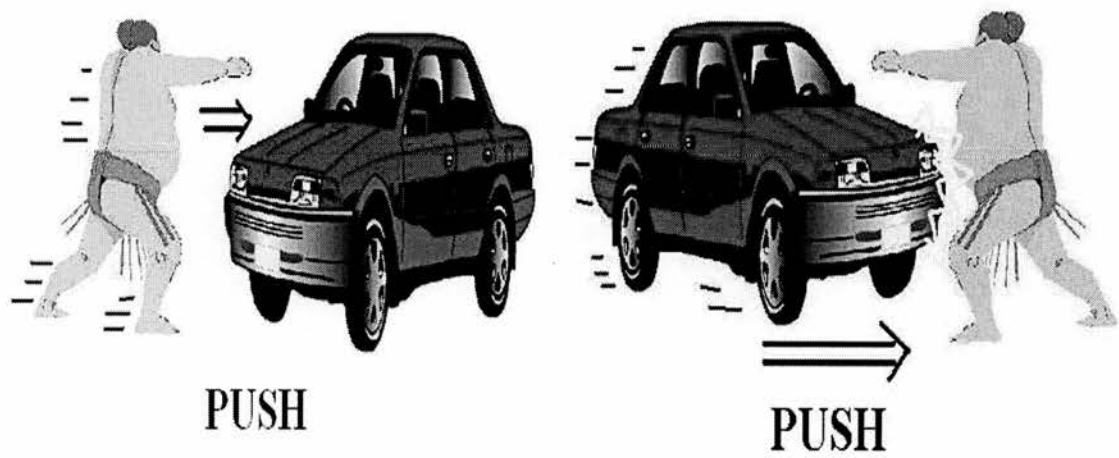
FLATTEN

Target picture 12



CRUSH

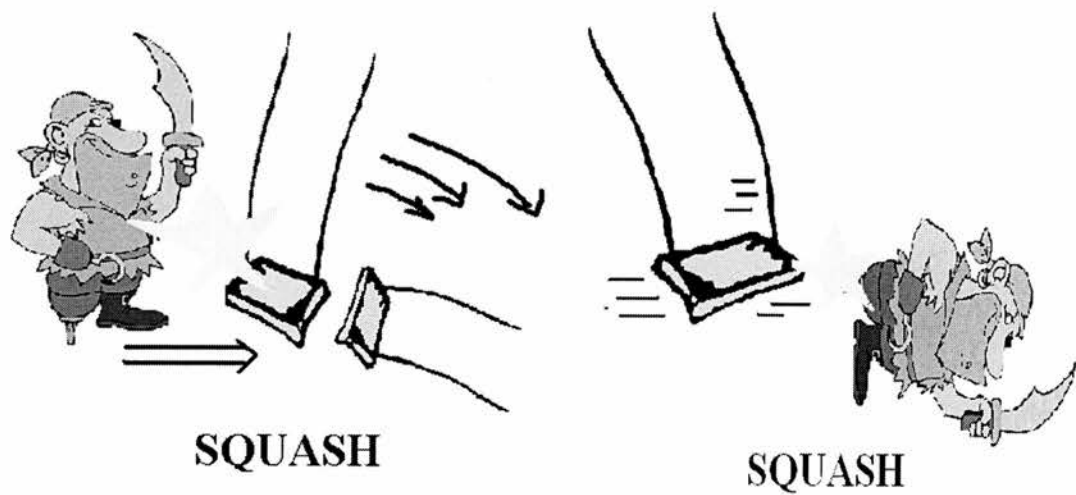
Prime pictures 13



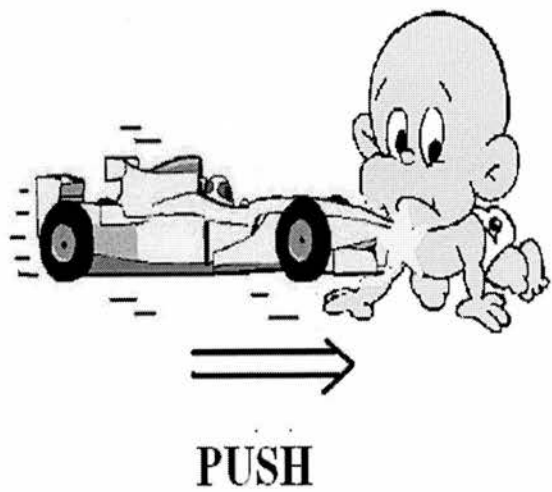
Target picture 13



Prime pictures 14



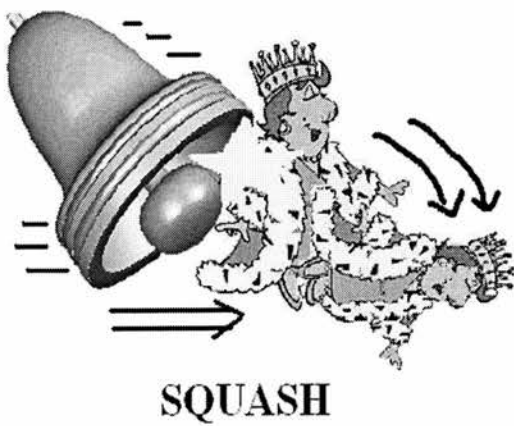
Target picture 14



Prime pictures 15



Target picture 15



Prime pictures 16



POKE



POKE

Target picture 16



SHAKE

Prime pictures 17

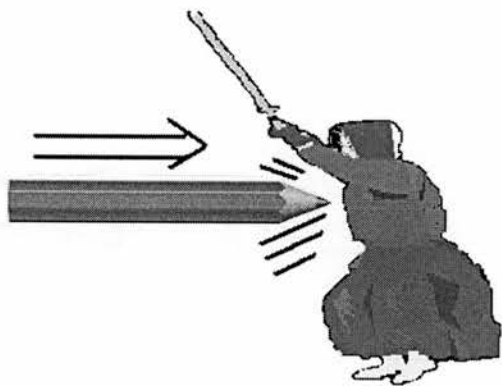


CARRY



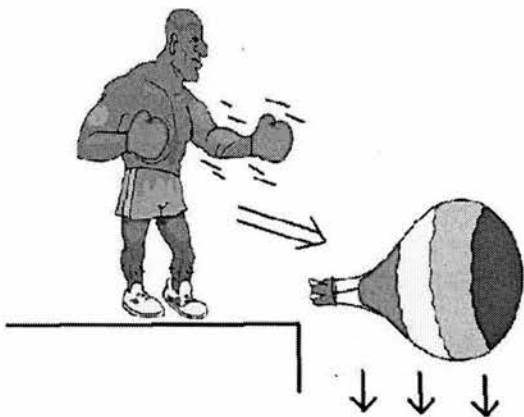
CARRY

Target picture 17

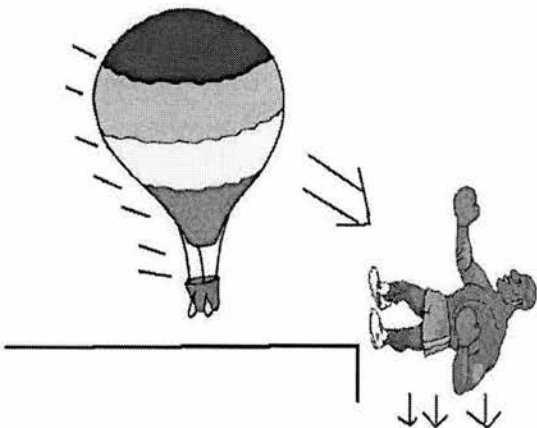


POKE

Prime pictures 18



KNOCK



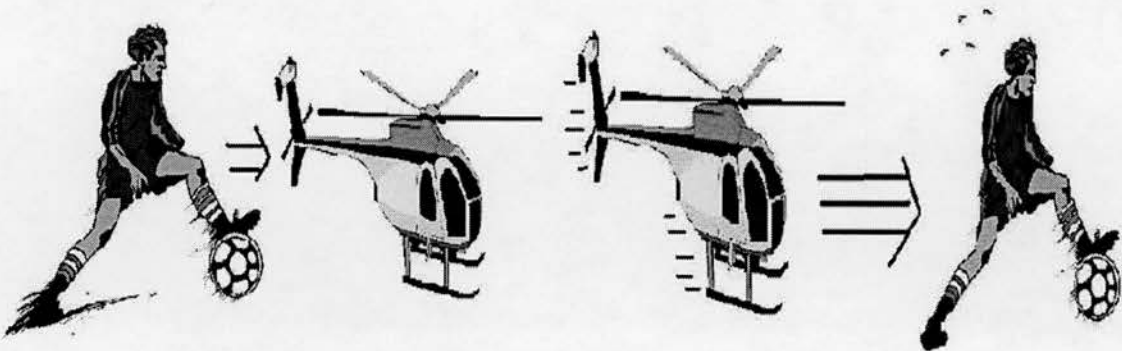
KNOCK

Target picture 18



CARRY

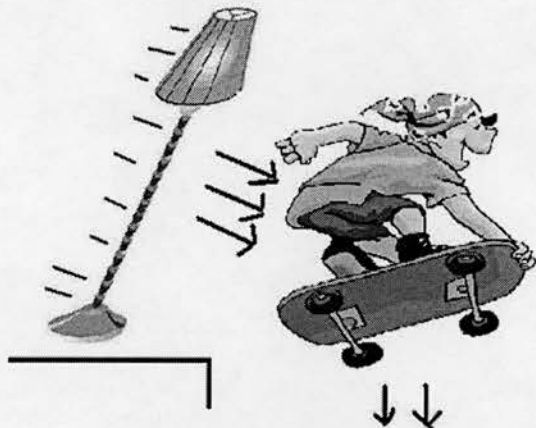
Prime pictures 19



CHASE

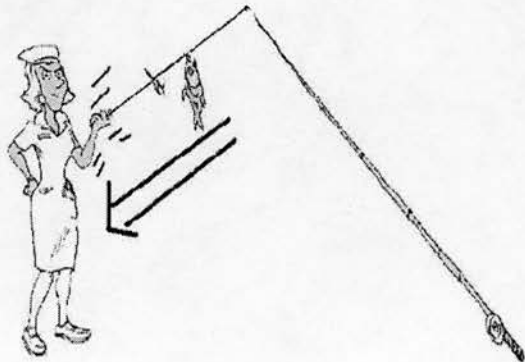
CHASE

Target picture 19

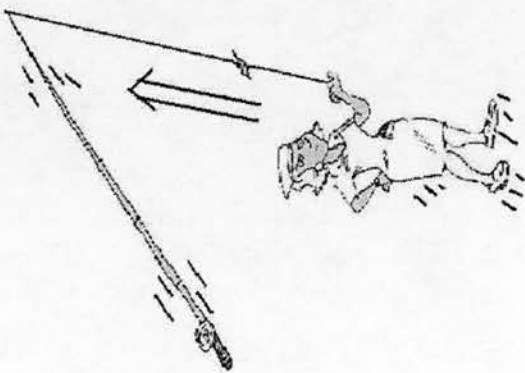


KNOCK

Prime pictures 20



DRAG



DRAG

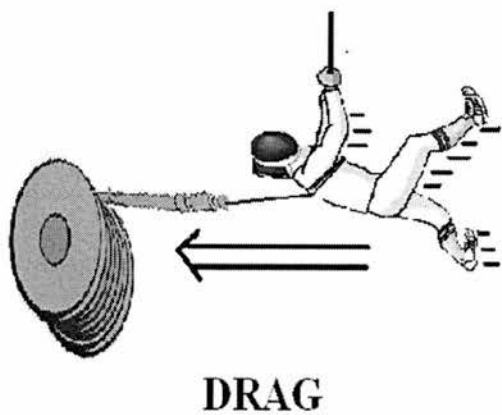
Target picture 20



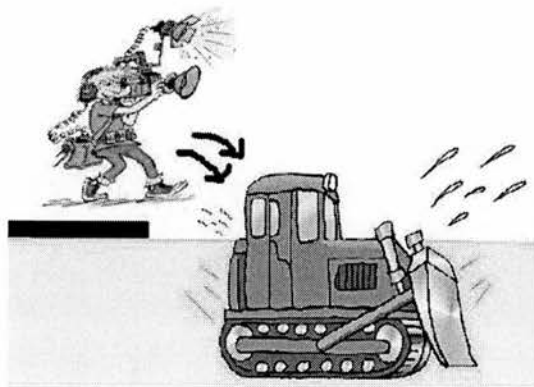
Prime pictures 21



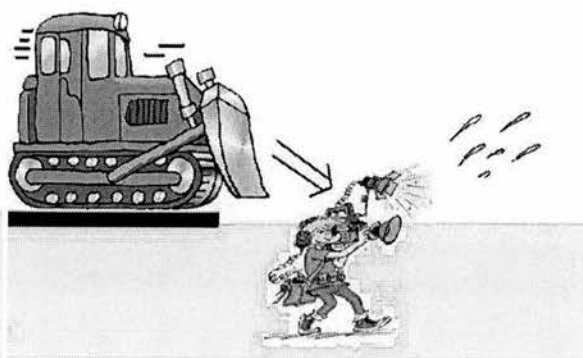
Target picture 21



Prime pictures 22



SUBMERGE



SUBMERGE

Target picture 22



HIT

Prime pictures 23

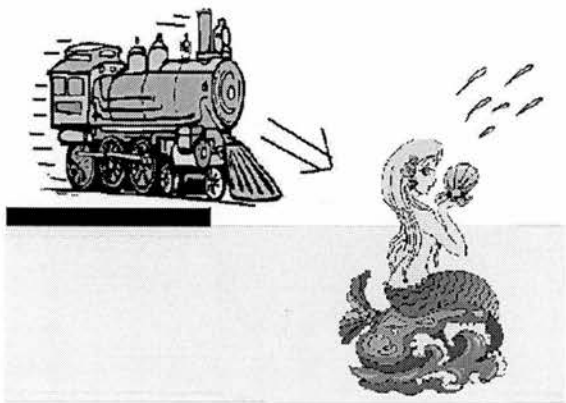


CRUSH



CRUSH

Target picture 23



SUBMERGE

Prime pictures 24



FLATTEN



FLATTEN

Target picture 24



CRUSH

Appendix 13: Experiment 5 Filler pictures

Prime 1 a – b

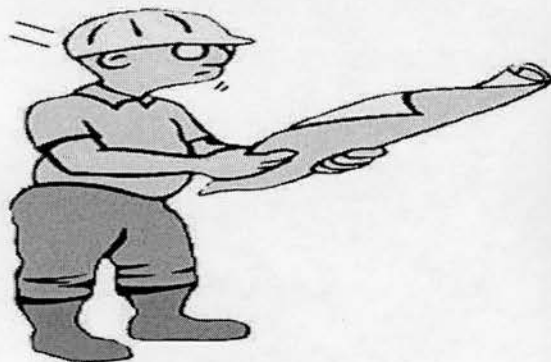


SMILE

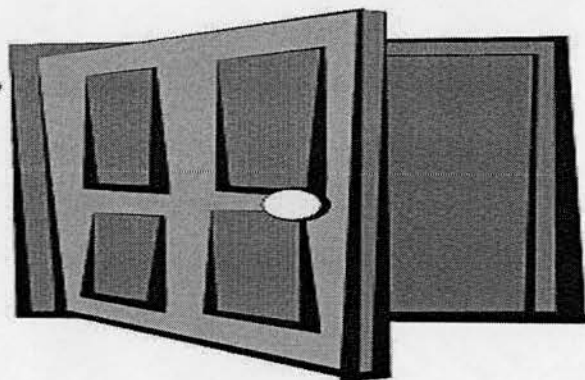


CRACK

Target 1 a - b



NOD

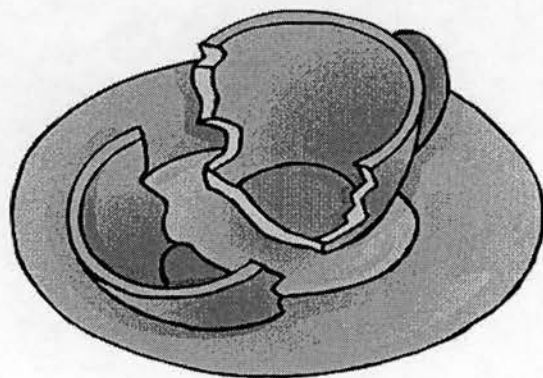


OPEN

Prime 2 a – b

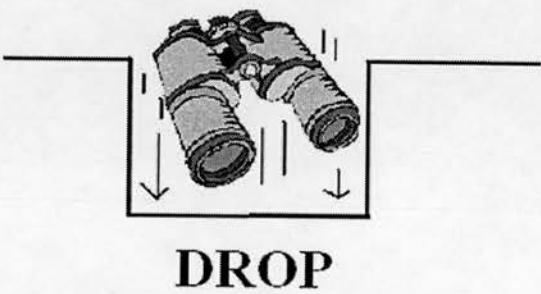
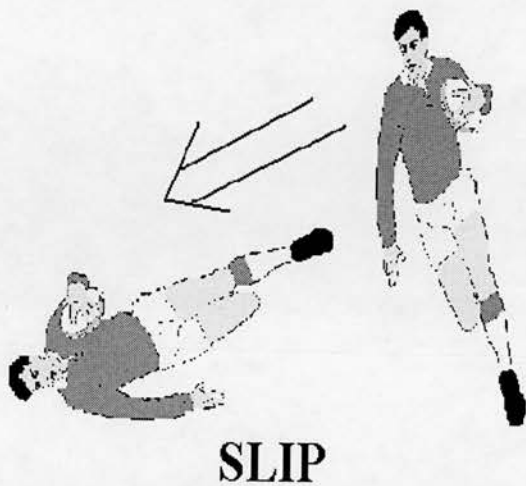


SING



CRACK

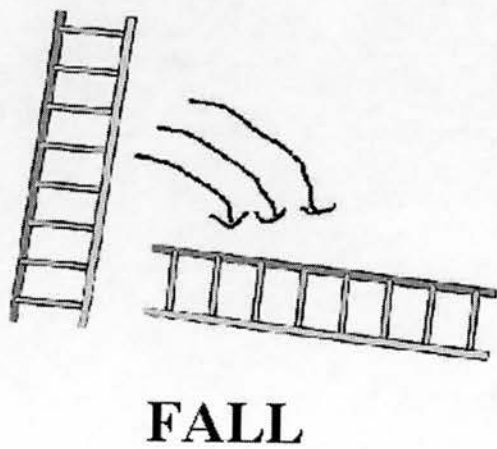
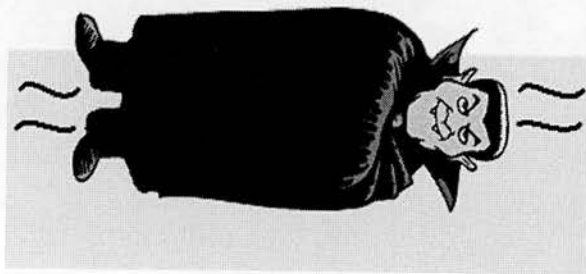
Target 2 a - b



Prime 3 a - b



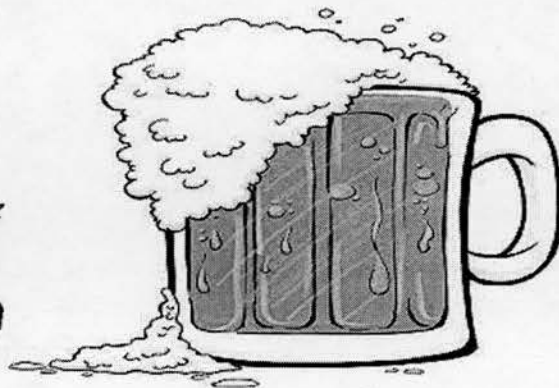
Target 3 a - b



Prime 4 a - b



NAP

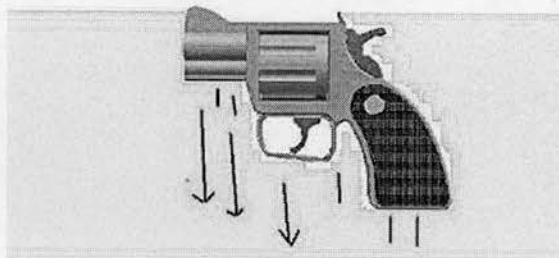


OVERFLOW

Target 4 a - b



WALK



DROP

Prime 5 a - b

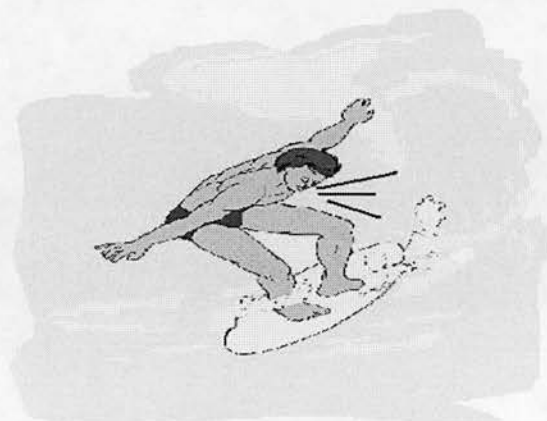


JUMP

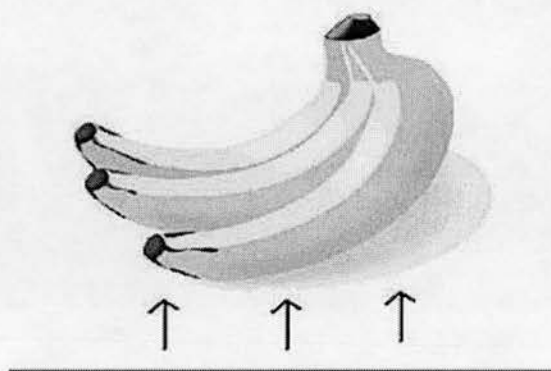


RING

Target 5 a - b



YELL

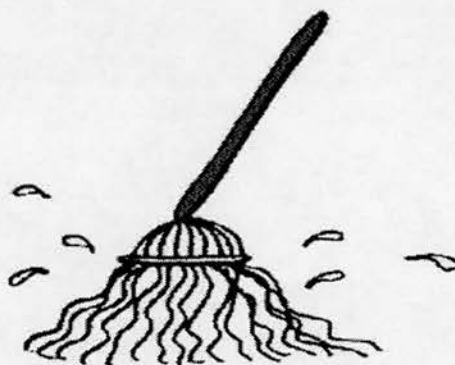


FLOAT

Prime 6 a - b



RUN

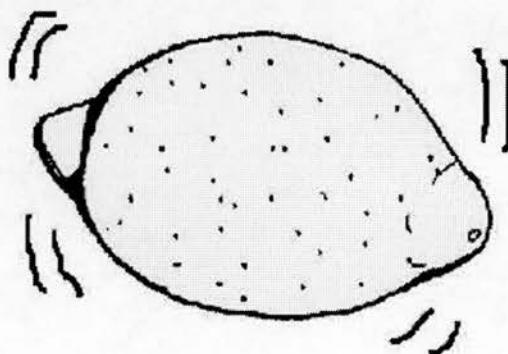


SPLASH

Target 6 a - b

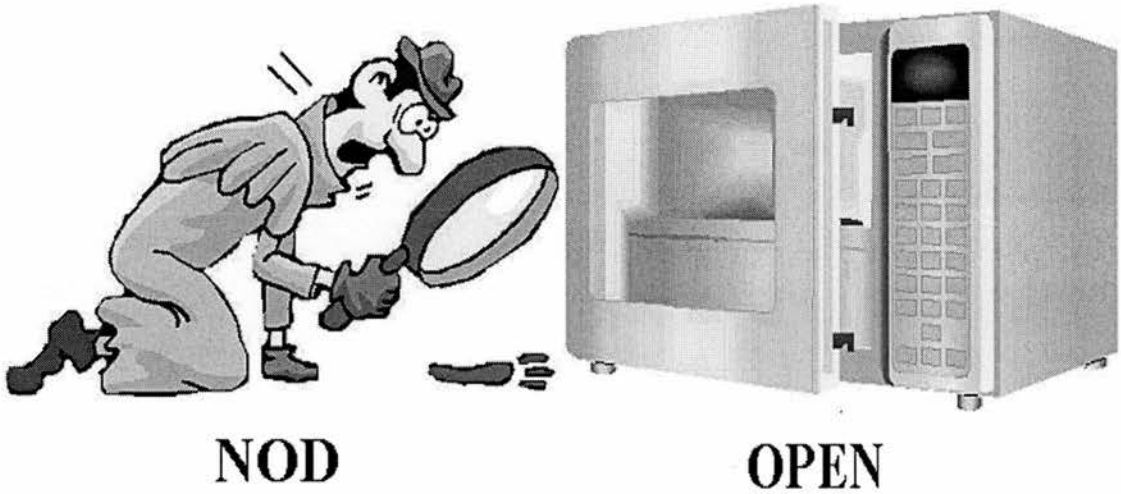


DANCE

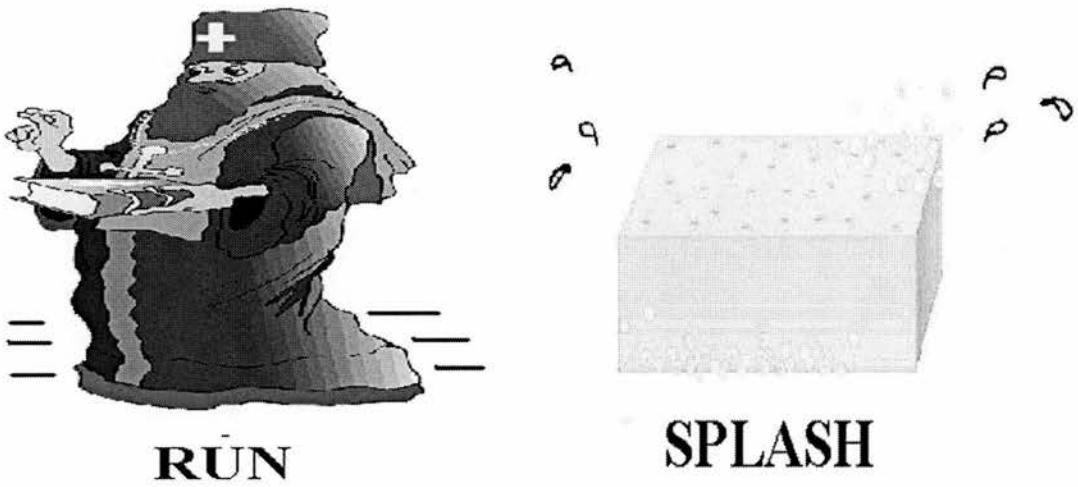


ROLL

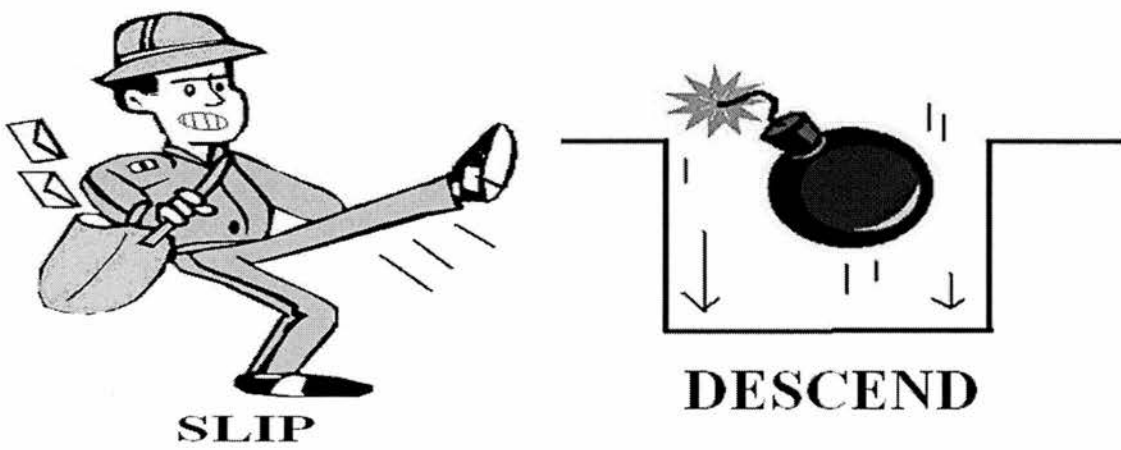
Prime 7 a - b



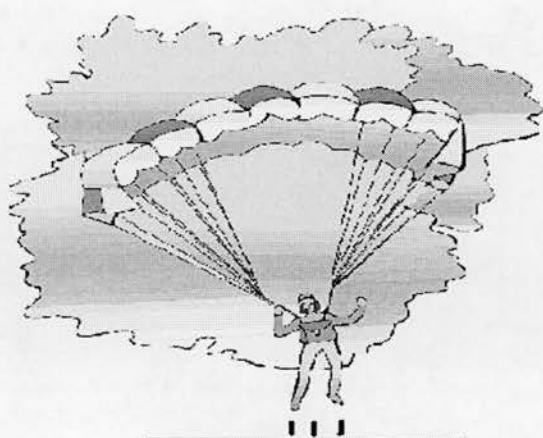
Target 7 a - b



Prime 8 a - b



Target 8 a - b

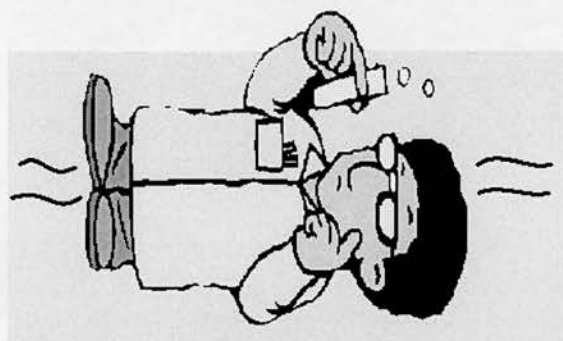


JUMP

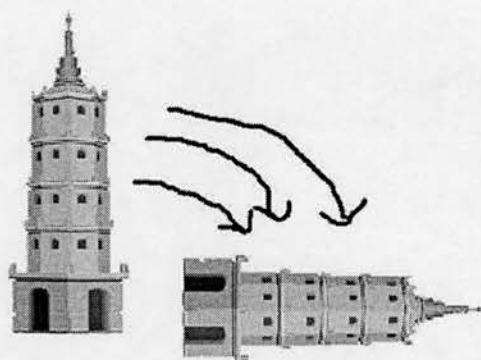


RING

Prime 9 a - b



SWIM



FALL

Target 9 a - b



SLEEP

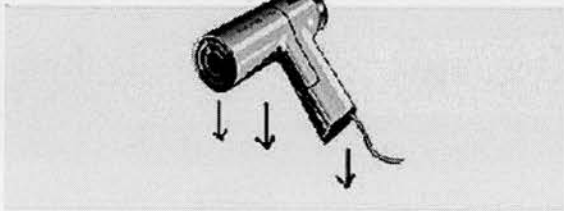


SPILL

Prime 10 a - b

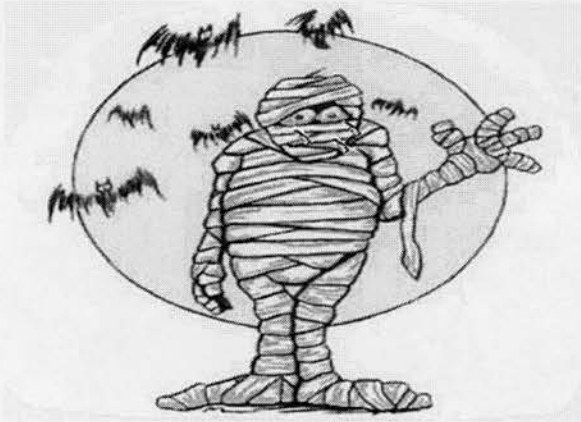


WALK

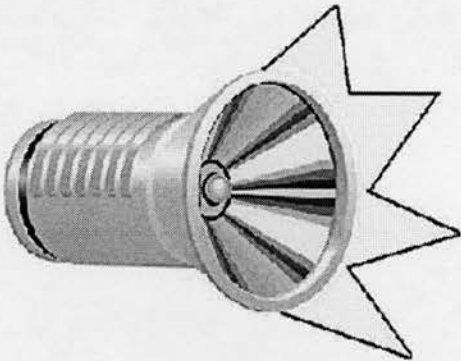


DROP

Target 10 a - b



CRY

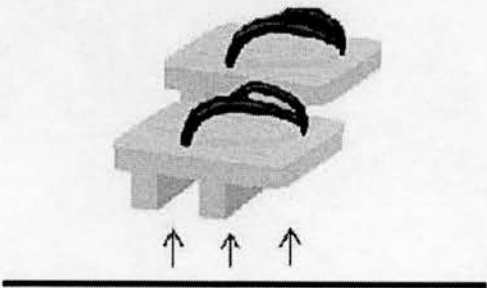


SHINE

Prime 11 a - b



YELL

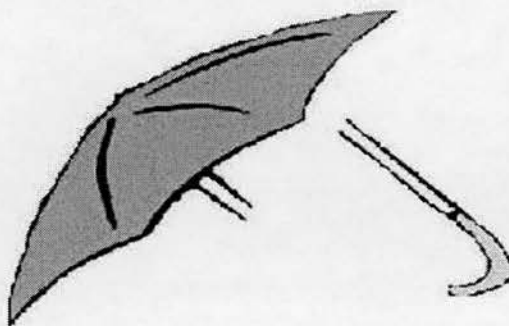


FLOAT

Target 11 a - b

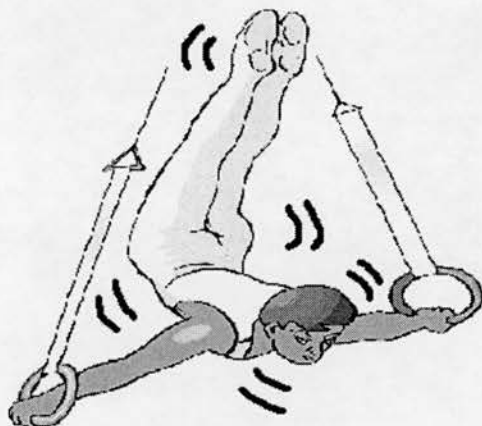


SING

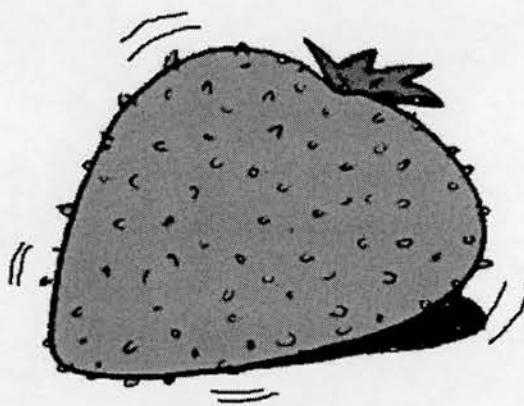


BREAK

Prime 12 a - b



DANCE

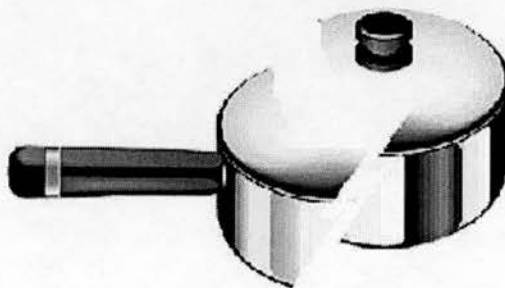


ROLL

Target 12 a - b



SMILE

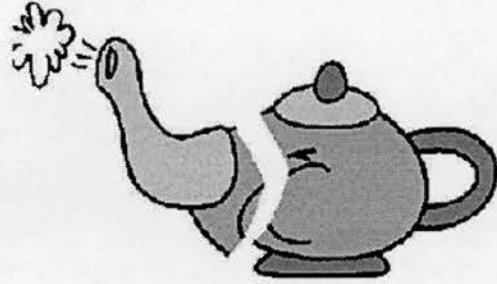


BREAK

Prime 13 a - b



SMILE

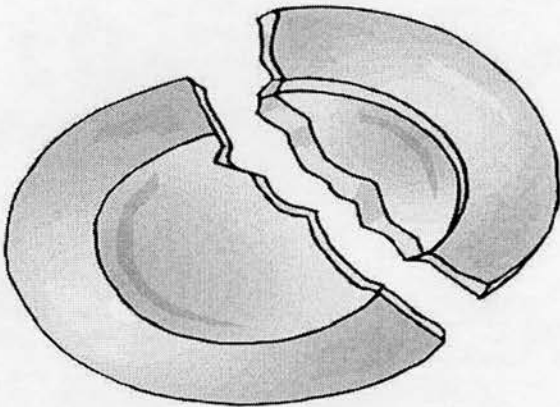


BREAK

Target 13 a - b



SING

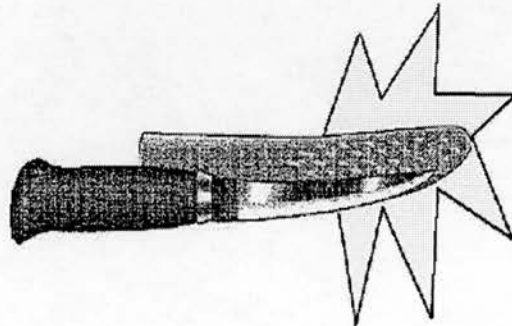


CRACK

Prime 14 a - b



CRY



SHINE

Target 14 a - b



SLEEP

Prime 15 a - b



SPILL



JUMP



RING

Target 15 a - b



RUN

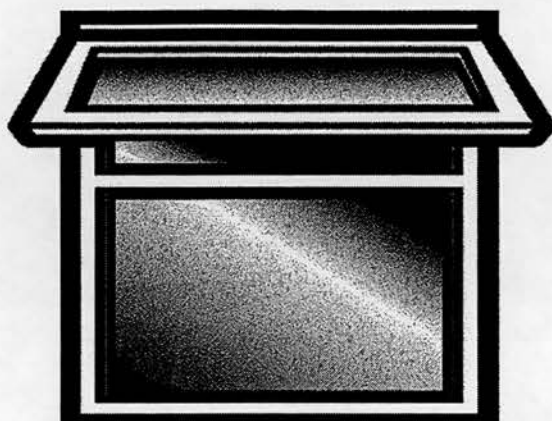


SPLASH

Prime 16 a - b



NOD

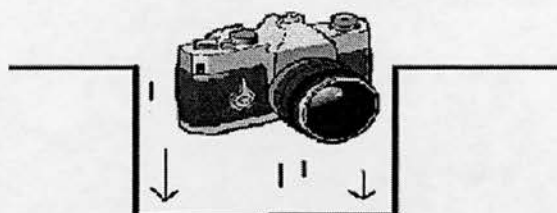


OPEN

Target 16 a - b

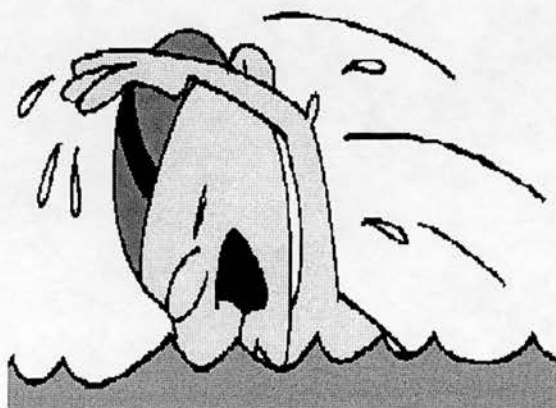


SLIP

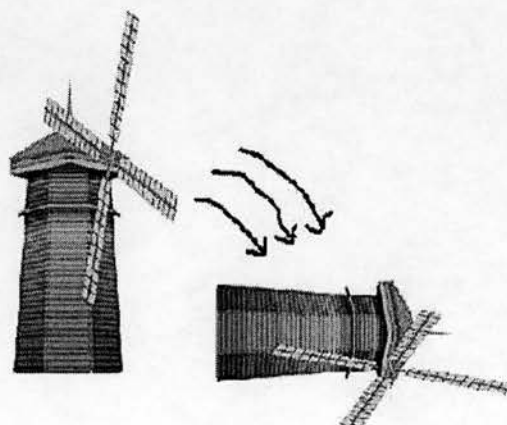


DROP

Prime 17 a - b



SWIM

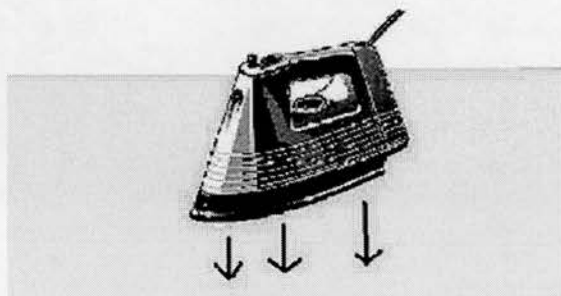


FALL

Target 17 a - b



WALK

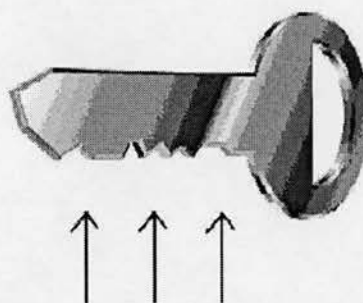


DROP

Prime 18 a - b



YELL

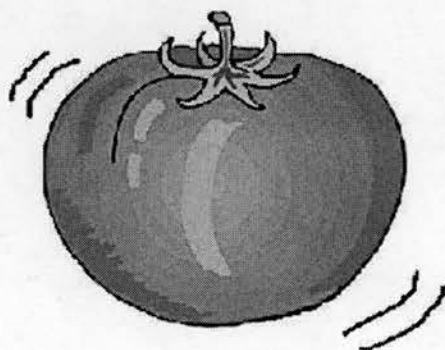


FLOAT

Target 18 a - b



DANCE



ROLL

